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Learning styles, learning outcomes and course satisfaction: an investigation of a blended computer literacy course

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Learning styles, learning outcomes and course satisfaction: An investigation of a blended computer literacy course

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

This study examines the relationships among learning styles, learning outcomes and course satisfaction in a blended computer literacy undergraduate course at Iowa State University. Based on results from Kolb's Learning Style Inventory (1999), participants were classified into one of the four learning styles: Accommodator, Assimilator, Converger or Diverger. The analyses of quantitative data (final grades, online survey) and qualitative data (interviews) indicate that there was little relationship between learning styles and learning outcomes as measured by final grades, and between learning styles and course satisfaction assessed from general feelings, communication and interaction, course organization, assessment, and weekly lab session in a blended learning environment. These findings support the research results as shown in Larsen (1992), Shih & Gamon (1999), and Wang, Hinn and Kanfer (2001). Quantitative data analysis showed a significant relationship between learning styles and course expectations, and between learning styles and the perceived value of the course schedule. Three students selected to represent three learning styles (all female) valued the blending of on site labs with the web-based lecture component, whereas the only Converger interviewed (a male) did not value the blended on site lab activities that complemented the web-based lecture component. This study suggests that blended learning offers a good opportunity to maximize students' learning as stated by Singh (2003) and Thorne (2003).

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CHAPTER 1. INTRODUCTION

The purpose of this research study is to investigate how learning styles are related to students' learning outcomes and course satisfaction in a blended computer literacy course at the undergraduate level at Iowa State University. This chapter is divided into four sections: a) introduction; b) statement of the research problem; c) purpose of the study; and d) definitions of terms.

Introduction

Learning style has been identified as a variable with which to assist learners in improving their learning process (Brant, 1990; Claxton & Murrell, 1987; Curry, 1983; DeBello, 1990; Kolb, 1984; Price, 1983). It is therefore important to investigate how learning style affects the learning process and how learning can be developed and improved via the recognition of learning style. Helping learners to be more effective and efficient in their learning has become a concern for educators (Corno & Snow, 1986; Dunn & Dunn, 1978; Grasha, 1996; Schmeck, 1983; Sadler-Smith, 1997).

It has been widely recognized in research that individuals have different learning styles (Cornett, 1983; Claxton & Murrell, 1987; Dunn & Dunn, 1978; Keefe, 1979; Kolb, 1984). Each person possesses an individual approach to learning that appears to be woven into the formation of his/her growth and development in learning capabilities. The knowledge of students' learning styles provides some basic principles with which instructors can plan and design course materials to accommodate and strengthen such learning preferences (Claxton & Murrell, 1978; Dixon, 1985; Pask, 1988). Claxton and Murrell (1978) suggest that the information on student learning styles can be used in three ways. In addition to use by instructors to enhance effective learning, a student may regard it as a tool

for planning education efforts, and it can be used as a useful means for further personal growth and satisfaction, and an institution may use it to improve curriculum and program development.

The concept of learning style is receiving growing acceptance for educators (Claxton & Murrell, 1987; Cornett, 1983; Curry, 1983; Dunn & Dunn, 1978; Keefe, 1979; Kolb, 1984). Learning style information is viewed as a promising way to improve teaching effectiveness, curriculum design, and the instructional process (Cahill & Madigan, 1984; Keefe, 1982; Lenehan, Dunn, Ingham, Murray & Signer, 1994; McLoughlin, 1999; Mickler & Zipper, 1987; Sims & Sims, 1995).

As we look at the impact of learning styles in a traditional classroom setting, its influence on the learning and teaching process in a distance learning setting should not be ignored. While the influence of learning styles in traditional face-to-face instruction has been examined (Dunn & Griggs, 2000; Keefe, 1979; Price, 1983), little is known about the role that learning styles play in distance education (Billings & Cobb, 1992; Merisotis & Phipps, 1999). Important relationships among variables such as learning styles, learning outcomes and course satisfaction in learning at a distance have been identified (Allen, Bourhis, Burrell & Mabry, 2002; Diaz & Cartnal, 1990; Dille & Mezack, 1991; Gee, 1990; Miller, Always & McKinley, 1987; Neuhauser, 2002; Terrell & Dringus, 2000; Terrell, 1995). These research findings suggest that constructs such as learning styles are important factors when developing an effective distance learning program.

Distance education can offer flexibility and convenience to students and may bring a positive learning opportunity (Kearsley, 2000; Moore, 1990; Moore & Kearsley, 1996; Picciano, 2001). Learning style has been identified as one of the characteristics which can

impact the learning process of the distant learning student (Billings & Cobb, 1992; Campbell, 1992; Gee, 1990; Terrell, 1995). It may play an important role in achievement and satisfaction levels of the distance learning student (Diaz & Cartnal, 1999; Dille & Mezack, 1991; Terrell & Dringus, 2000). Information concerning the potential student's preferred learning styles may also influence design considerations and instructional strategies in distance learning (Gunawardena & Boverie, 1993; Hackman & Walker, 1990; Lynch, 2002; McLoughlin, 1999).

Information technology is now developing rapidly and dramatically, and it has been and will be increasingly and widely applied to different fields. Technology integration into the teaching and learning process is currently a hot topic in the educational field, and distance education is emerging as a dynamic, vital and alternative delivery mode which takes advantage of information technology to enhance learning effectiveness. Educational institutions all over the world at different levels, and especially higher education, are offering a wide variety of online courses across numerous disciplines (Moore, 1990; Moore & Kearsley, 1996; Picciano, 2001).

Another new term, blended learning, is now fully developed as a way of complementing face-to-face instruction and distance learning (French, Olrech, Hale & Johnson, 2003; Osguthorpe & Graham, 2003; Singh, 2003; Thorne, 2003). Blended learning takes advantage of the power of technology to deliver learning materials anywhere and anytime, while technology serves as a tool to help students engage in their learning. Although distance learning is emerging as a major trend in education, blended learning has it own place and is developing as another extension and adjunct to distance education (French et al., 2003; Thorne, 2003). This form of learning will most likely be the way of the future (Veronikas &

Shaughnessy, 2004), because it offers the convenience and flexibility of online courses without the loss of face-to-face contact and interaction.

The major benefit of online learning is its anywhere/anytime nature. This allows each student to learn at his/her own pace and to take responsibility for his/her own learning processes based on individual learning styles. By understanding of the strengths and weaknesses of face-to-face and online learning, the potential of blended learning may be optimized (Singh, 2003; Thorne, 2003).

Research on learning styles is extensive. Some researchers focus on classification and models (Curry, 1983; Partridge, 1983), some design and develop instruments as tools to measure different types of learning styles (Dunn, Dunn, 1978; Keefe, 1979; Kolb, 1984), while others emphasize on the matching of learning styles in the learning and teaching process (Ford & Chen, 2001; Mickler & Zipper, 1987; Miller, Always & McKinley, 1987). Researchers have also addressed the importance of learning styles in a traditional face-to-face classroom instruction from different angles (Claxton & Murrell, 1987; Cornett, 1983; Dunn & Dunn, 1978; Grasha, 1996; Keefe, 1979). However, a thorough study of learning styles on distance learning, and in particular, that of a blended learning mode is lacking (Parkinson, Greene, Kim & Marioni, 2003).

Blended learning resembles both distance learning, and traditional education in the learning process, because they all involve interaction between learners and instructor, a learning setting, instruction and instruction outcome (Bertrand-Hines, 2000). It seems worthwhile to expand efforts toward assessing learning styles and preferences in a blended learning environment, thus this research study investigates the relationships of learning styles

with learning outcomes and course satisfaction in a blended learning setting and hopes to get useful information to enhance student learning.

Statement of the Research Problem

There are an abundance of studies focusing on the effect of students' learning style preference and learning outcomes in a traditional classroom setting (Anderson & Benjamin, 1994; Matthews, 1991; Schmeck & Grove, 1979); however, in a distance learning setting, no research consensus has been reached (Billings & Cobbs, 1992; Ford & Chen, 2001; Hackman & Walker, 1990). Some claim that academic achievement and satisfaction are positively affected when teaching correlates with a student's preferred learning style in a formal classroom setting (Dunn & Dunn, 1978; Mickler & Zipper, 1987; Miller et al., 1987; Price, 1983). Past research also indicates that the way students perceive their learning abilities and their demands required from different media significantly influence their attitude and their overall learning performance (Baldwin & Sabry, 2003; Gunawardena & Boverie, 1993; Grasha, 1996).

With regard to current research on distance learning, most of it has focused on technology integration, collaborative learning, or program development. Other research has focused on demographic information, challenges and barriers in distance learning, student frustration and satisfaction with online learning. However, research studying students with respect to all these aspects needs further exploration. Davis and Carlsen (2004) claim that recent research on learning and pedagogy for information technology is not consistent with current assessment of students, and more work is needed to ensure educational attainment. Taking learner needs and learning styles into account, according to Grasha and Yangarber-Hicks (2000), "The literature on the connections of technology to teaching and learning

styles is not well developed" (p.7). Valenta, Therriault, Dieter and Mrtek (2001) state that "further research is necessary to understand how learning styles contribute to the experience of online education" (p.9). Therefore, an empirical study is needed to investigate how learning styles might be related to successful and effective learning experience in a blended course. This particular study examines learning styles, learning outcomes and course satisfaction in the context of a blended learning environment.

Purpose of the Study

This study seeks to understand the relationships among learning styles, learning outcomes, and course satisfaction in an undergraduate course delivered both via online lectures in WebCT and on-site lab sessions. The work of Kolb (1984, 1985) on Experiential Learning theory and learning styles inventory is selected as both the theoretical framework and the instrument for this investigation. The research questions are:

1. What, if any, relationship exists between learning styles as measured by Kolb's Learning Style Inventory and learning outcomes as measured by participants' Com S 103 final grades?
2. What, if any, relationship exists between learning styles and course satisfaction?
3. What, if any, relationship exists between learning styles and student performance?

Definition of Terms

For the purpose of this study, the following definitions will be used:

1. **Learning style**: The individual's preferred ways of grasping and transforming information (Kolb, 1984).
2. **Learning Style Inventories or Instruments:** Valid and reliable tests which measure one or many aspects of learning style.

3. **Distance education/ learning:** The acquisition of knowledge and skills through mediated information and instruction, encompassing all technologies and other forms of learning at a distance (Robyler, Edwards & Havriluk, 2000, p. 192).
4. **Blended learning:** A method of educating at a distance that uses technology (high-tech, such as television, or the Internet and low-tech, such as voice-mail or conference calls) combined with traditional education or training (Smith, 2001).
5. **Learning outcome:** An expected result of learning indicating what a learner should understand and be able to accomplish in a course or program.
6. **Course satisfaction:** The fulfillment and contentment gained by the student from learning experiences in a course.

CHAPTER 2. LITERATURE REVIEW

The purpose of this chapter is to present a review of literature on learning styles, and its relationships to learning outcomes and course satisfaction in traditional, distance and blended learning settings. The chapter includes the following sections: a) learning styles; b) learning outcomes and course satisfaction; c) learning styles in distance education; d) learning styles in blended learning; and e) summary. Each section explains relevant theories and describes related research.

Learning Styles

According to Cohen (1997), learning styles can play an important role in directing both teaching methods and the methods by which students read an assigned text, synthesize information, solve problems, and demonstrate knowledge. Students have different learning styles – characteristics, strengths and preferences in the ways they assimilate and process information, with each style of learning having its own unique strengths and weaknesses. The different ways that people acquire knowledge form the concept of learning styles.

Definition and description of learning styles

Learning styles have been variously defined as the individual's preferred way of grasping and transforming information (Kolb, 1984); the characteristic method of receiving and using information in learning (Sadler-Smith, 1997); the product of a group of information-processing activities that individuals use when confronted with a learning task (Schmeck, 1983); the preferences of students on how they interact with their peers, the teacher, and the content (Grasha, 1996); and the way students begin to concentrate on, process, internalize and remember new and difficult academic information (Dunn & Dunn, 1978). The emphasis on preferred ways of perceiving and processing information in Kolb's

definition (Kolb, 1984, 1985) implies that these ways are not the only or the best ways for the individual to learn a subject matter, but there is an implication that the individual's learning strengths are reinforced (Dixon, 1985). Kolb (1984, 1985) described a four-stage learning cycle that the learning starts from concrete experience, then a learner reflects and thinks from the previous experience, builds up abstract ideas and theoretical models from the reflection, then uses these theories to make decisions and solve problems. This cycle needs to be developed and promoted to perceive and process information and form new knowledge (Kolb, 1984).

The definition used by Kolb (1984) is preferred in this study because it interprets how learners perceive and process information and fits the Experiential Learning Theory (Kolb, 1984), the theoretical framework that was used in this study.

Learning style is not fixed to an individual, task and situation. Smith (2000) argues that "it is a current state of mind or of operating" (p.5). It varies by time, motivation, age, experience, maturity and other conditions of learners with gradual development. However, it is relatively persistent in the behavior of individual learners (Dunn & Griggs, 2000; Keefe, 1979) by a combination of nature and nurture (Cornett, 1983). Students' learning styles may go through transition in progressing through elementary, middle and high school, and they may continue to change in college and during adulthood (Dunn & Griggs, 2000; Price, 1983), the styles of older people in their 60s-70s may differ in many ways from those of younger people (Van Wynen, 1997). However, it is possible to anticipate certain stable behavior and learning style patterns of students during a particular time period so that students may be aware of the weakness and strength of learning modes, and instructors might utilize them in course design and implementation.

Learning styles models and instruments

Over the years, researchers have developed instruments for assessment of learning styles in the learning process, a topic of much interest in exploring the implications for effective learning and teaching, course design, and curriculum development. Various models and classifications of learning styles have come into existence (Claxton & Murrell, 1987; Curry, 1983; Keefe, 1979). The diversity in these models and instruments has caused confusion in terminology, definitions and implementation, sometimes puzzling educators who have adapted certain learning style instruments to measure learning styles of students for specific purposes and contexts. Curry (1990) claims that three pervasive problems exist in the research of learning styles: 1) confusion in definitions; 2) weakness in reliability and validity of measurements; and 3) identifications of relevant characteristics in learners and instructional settings.

A variety of frameworks and instruments have been used to identify and measure learning styles. Curry (1983) reorganized the learning style instruments into a three-layer model often referred as the onion model and having the following components: 1) instructional preference; 2) information processing style; and 3) personality-related style (See Table 1). She spent five years conducting a psychometric survey of 21 learning style conceptualizations and instruments and reorganized them into this onion model based on psychometric evidence and written documentation.

Instructional preferences, the outermost layer, mean the individual's choice of how to learn (lectures, reading, small-group, demonstrations, etc). Since this layer interacts most with learner expectations and other external factors, it is not stable and subject to change

under different situations and contexts, bringing challenges as to how to precisely measure instructional learning preferences.

Information processing preferences, the second or middle layer of the learning style onion model, refer to the individual's intellectual approach to assimilating information (orienting, sensory loading, short-term memory and long-term storage). This layer does not directly involve the external environment, and it is considered to be more stable and less likely to change.

Cognitive personality-related preferences, the third or innermost of layer of the onion model, indicate the individual's approach to assimilating and adapting information. This adaptation does not directly interact with the environment, and it may contain some personality constructs with a relatively permanent nature. Hence, this layer is considered to be stable and permanent, and easy to measure by way of learning style instruments.

Table 1. Review of Curry's Onion Model

Levels of Model	Learning Style Instrument	Author(s)
1. Instructional Preference	Learning Style Inventory	Canfield & Lafferty (1980)
	Learning Style Inventory	Dunn, Dunn & Price (1981)
	Student Learning Interest Scales	Grasha & Riechman (1974)
	Instructional Preferences	Friedman & Stritter (1976)
	Oregon Instructional Preference Inventory	Goldberg (1969)
	Cognitive Preferences Test	Heath (1972)
	Cognitive Style Interest Inventory	Hill (1978)
	Learning Preference Inventory	Rezler & Rezmovic (1981)
2. Information Processing Preference	Study Process Questionnaire	Biggs (1978)
	Approaches to Studying	Entwistle & Ramsden
	Learning Style Inventory	Kolb (1985)
	Paragraph Completion Method	Hunt (1978)
	Learning Process Inventory	Kempa & Dube (1973)
	Learning Modalities Inventory	Papalia (1978)
	Inventory of Learning Process	Schmeck & Ribbich (1977)
3. Personality-Related Preference	Concept of Duality	Gregorc & Ward (1977)
	Matching Familiar Figures Test	Kagan (1965)
	Myers-Biggers Type Indicator	McCaulley (1978)
	Conservation Theory	Pask (1976)
	Embedded Figures Test	Witkin (1981)
	Edmonds Learning Style Exercise	Reinert (1976)

Note: Adapted from Curry (1983)

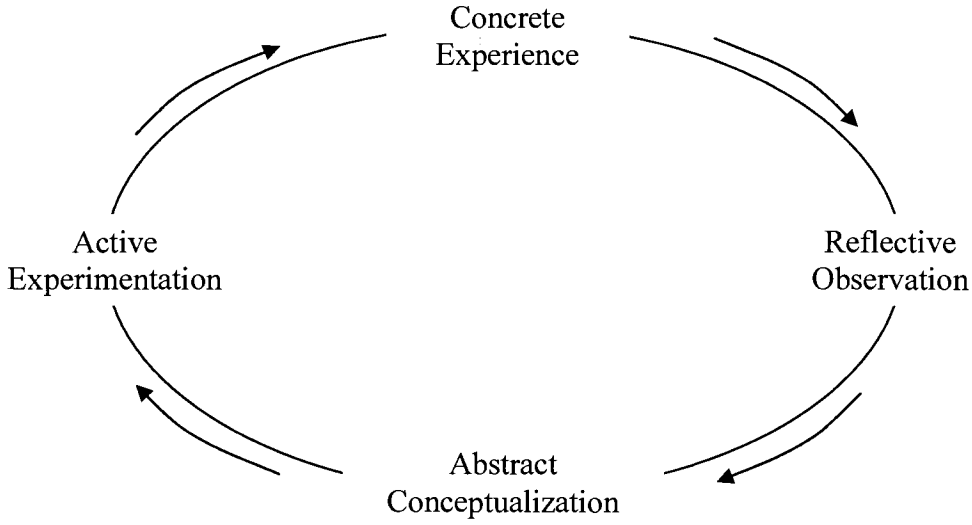
Kolb's Experiential Learning Theory (ELT)

Experiential Learning, as defined by Kolb (1984) "is the process whereby knowledge is created through the transformation of experience" (p.37). Knowledge is established from "the combination of grasping and transforming experience" (p.38). Experience usually plays an extraordinary role in the learning process.

Kolb (1984) developed his Experiential Learning theory based on Dewey, Lewin and Piaget. His theory has become one of the best-known learning style theories. It generates ideas from Dewey's (1938) experience-learning theories that stress the need for learning to be grounded in experience, Lewin's (1935) perspective that emphasizes the importance of being active in learning, and Piaget's (1985) concentration on intelligence as the result of the interaction of person and environment. These theories lay the foundations for developing Kolb's Experiential Learning Theory.

The Experiential Learning Theory (ELT) conceives learning as a four-stage learning cycle (Figure 1). It is indicated by two-bipolar dimensions, respectively Concrete Experience (CE) - Abstract Conceptualization (AC), and Active Experimentation (AE) - Reflective Observation (RO). The cycle usually starts with concrete experience that forms the basis for observation and reflection on learning experiences. These observations are assimilated into concepts and generalizations about experiences, which, in turn, guide new experiences and interactions with the world. Thus, the loop is closed and a learning style is formed.

Figure 1. Kolb's Experiential Learning Theory



Note: adapted from Kolb (1984, p.19)

Kolb (1985, 1999) indicated that all four learning style types are needed by learners, but the dominant type within an individual provides the main strength of that individual's approach to learning. Kolb (1984) also claimed that no matter what phases of the learning cycle learners prefer, it is important to build strengths in the other phases in order to be a well-rounded and effective learner.

Kolb (1984) depicted the uniqueness of his theory:

> The experiential learning model represents an integration of many of the intensive lines of research on cognitive development and cognitive style. The result is a model of the learning process that is consistent with human cognition and the stages of human growth and development. It conceptualizes the learning process in such a way that correlations in individual learning styles and corresponding learning environments can be identified.... The theory is called experiential learning for two reasons. First, this term ties the theory historically to its intellectual origins in the social psychology of Kurt Lewin in the forties and the sensitivity training of the fifties and sixties. Second, it emphasizes the important role that experience plays in the learning process (1981, p.235).

The Experiential Learning Theory (ELT) provides a holistic model of the learning process that connects with what we know about how people learn, grow and develop. It emphasizes that experience plays a vital role in the learning process that differentiates it from other learning theories. The theory has been widely accepted as a useful theoretical framework for learning-centered educational innovation, including instructional design, curriculum development and lifelong learning (Claxton & Murrell, 1978; Dixon, 1985; Kolb, 1999). It is believed that ELT helps learners understand learning at a deep and comprehensive level, considering that learning is a continuing process of interacting with experiences in one's life (Smith, 2000). It also provides guidance for applications to help educators improve their learning and design better processes in education and development (Kolb, 1984).

Since the core of ELT stresses the role of experience in learning, it builds up the theoretical framework to guide the analysis and investigation of this research study.

Kolb's Learning Style Inventory (LSI)

Kolb developed a learning style inventory to assess an individual's preferred learning style in the early 1970s, with two revised versions in 1985 and 1999, in terms of how a person deals with ideas and day-to-day situations. The learning style inventory provides learners with information about strengths and weaknesses in accomplishing tasks, solving problems, relating to and managing others, and realizing natural career choice preferences.

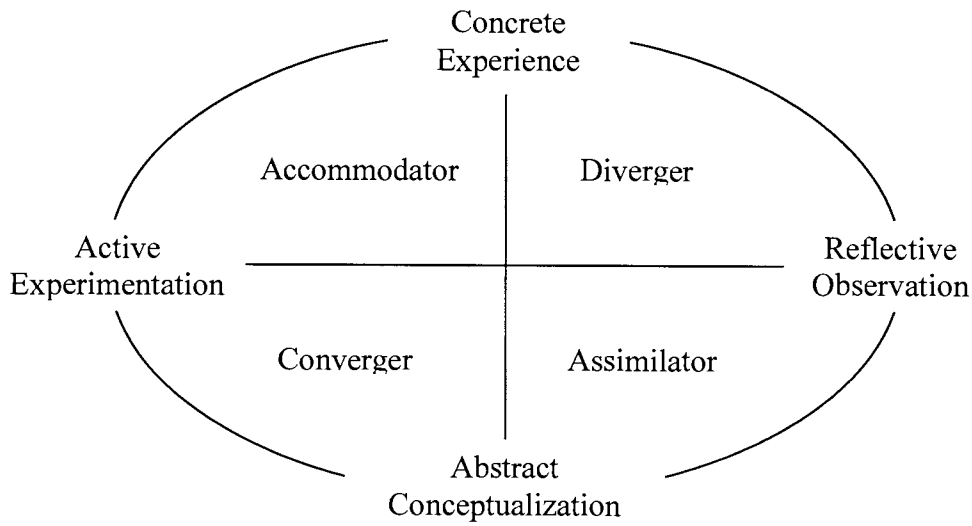
Kolb (1984, pp 67-68) developed this Learning Style Inventory with the following four objectives:

- The test should be constructed in such a way that an individual would respond to it in somewhat the same way as they would learn in a learning situation.

- A self-description format should be chosen for the inventory.
- The inventory should be constructed with the hope that it would prove to be valid – that measures of learning styles would predict behavior in a way consistent with the theory of experiential theory.
- The test should be brief, straightforward, and practical as a means of discussing the learning process and having feedback on the individual's own learning styles.

The inventory measures an individual's relative learning position on the abstract-concrete (Concrete Experience versus Abstract Conceptualization) and the active-reflective (Active Experimentation versus Reflective Observation) dimensions. People are separated into one of the four quadrants of these dimensions which can be described and labeled in terms of four basic learning styles (Accommodator, Diverger, Converger, and Assimilator) that determine how people go about their learning, see Figure 2.

Figure 2. Kolb's Learning Style and Experiential Learning



Note: From Experiential Learning (Kolb, 1984, p.21)

Figure 2 shows connection of Kolb's Experiential Learning theory and Learning Style. An orientation toward each learning mode in a full-stage cycle is briefly summarized below (Kolb, 1984, pp.68-69):

1. An orientation toward Concrete Experience (CE) focuses on being involved in experiences and dealing with immediate human situations in a personal way. It emphasizes feelings as opposed to thinking; a concern with the uniqueness and complexity of present reality as opposed to theories and generalizations; an intuitive, artistic approach as opposed to the systematic, scientific approach to problems.
2. An orientation toward Reflective Observation (RO) focuses on understanding the meaning of ideas and situations by carefully observing and impartially describing them. It emphasizes understanding as opposed to practical application; a concern with what is true or how things happen as opposed to what will work; an emphasis on reflection as opposed to action.
3. An orientation toward Abstract Conceptualization (AC) focuses on using logic, ideas and concepts. It emphasizes thinking as opposed to feeling; a concern with building general theories as opposed to intuitively understanding unique, specific areas; a scientific as opposed to an artistic approach to problems.
4. An orientation toward Active Experimentation (AE) focuses on actively influencing people and changing situations. It emphasizes practical applications as opposed to reflective understanding; a pragmatic concern with what works as opposed to pursuit of absolute truth; an emphasis on doing as opposed to observing.

Based on these four learning modes described above, Kolb has identified four basic learning styles (Table 2).

Table 2. Review of Kolb's Experiential Learning and Learning Style

Learning Mode	Description	Learning Style
Concrete Experience(CE) + Active Experimentation(AE)	- Learn from hands-on experience - More of a risk taker - Solve problem intuitively - Being adaptable and practical	Accommodator
Reflective Observation(RO) + Abstract Conceptualization(AC)	- Excel in inductive reasoning - Concern with abstract concepts rather than people -Strong ability to create and develop theoretical models	Assimilator
Abstract Conceptualization(AC) + Active Experimentation(AE)	- Strong in practical application of ideas - Focus on deductive reasoning on specific problems - Being unemotional	Converger
Concrete Experience(CE) + Reflective Observation(RO)	- Good at generating ideas and seeing things from different perspectives - Interested in people - Being imaginative, emotional and people oriented	Diverger

Note: Adapted from Smith (2001)

Limitations of Kolb's Experiential Learning Theory and Learning Style Inventory

Kolb's theory of Experiential Learning and the instrument, the Learning Style Inventory (LSI), have generated a large body of research in both traditional and distance learning settings (Bertrand-Hines 2000; Dille & Mezack, 1991; Dixon, 1985; Terrell, 1995; Terrell & Dringus, 2000; Wang, Hinn & Kanfer, 2001). However, debates and arguments about this theory and the inventory have not stopped.

Kolb's Experiential Learning Theory has been criticized for lack of sufficient experimental evidence and taking little account of different cultural experiences and conditions (Smith, 2000). Pickles (1996) points out that "learning includes goals, purposes, intentions, choice and decision-making", and that "it is not clear where these elements fit into the learning cycle" (p.108). Gardner (1993) argues that Kolb's learning styles focus on the

learners themselves. They do not describe what the influence of the environment to the learning process is and how it can be best understood or measured. Beard and Wilson (2002) argue that Kolb's theory does not illustrate the fact that a focus on experiential thinking based on action has limitations. It may result in false conclusions; it may not help learners understand and explain change and new experiences; and it may cause mental laziness and dogmatic thinking.

As for the Learning Style Inventory, Kolb (1984) himself and other researchers (Cornwell, Manfredo & Dunlap, 1991; Pickles, 1996; Sims, Veres, Watson, & Buckner, 1986; Wilson, 1986) recognized its limitations. First, the results are based solely on the way learners rate themselves. Second, the inventory does not rate learning style preferences through standards or behavior. Third, validity and reliability have been questioned and critiqued. Both the original and revised versions (1976, 1985, and 1999) of the LSI are deficient in reliability and construct validity (Cornwell et al., 1991; Pickles, 1996; Sims et al., 1986; Wilson, 1986). Study results indicate that internal consistency and test-rest reliabilities for LSI scores fluctuate considerably and contribute to cumulative measurement error (Atkinson, 1991; Loo, 1996). While the Kolb model has undergone scrutiny by researchers debating the LSI's validity and reliability, it is still, however, viewed as a valuable framework for learning activities (De Ciantis & Kirton, 1996; Willcoxson, & Prosser, 1996). Boyatzis and Kolb (1991) found after an intensive review of a myriad of instruments that the Kolb's LSI had a strong reliability and a fair validity. Additionally, Kolb (1999) reported that the Kolb's LSI was updated in 1999 to "improve the psychometrics of the instrument" (p.10).

Regardless of the objections and criticism to Kolb's theory and/or learning style inventory, his theory and learning style inventory have been very influential in education and management development. The work of Kolb has influenced the work of many in the learning, development and educational fields (Bertrand-Hines 2000; Dille & Mezack, 1991; Gunawardena & Boverie, 1993; Terrell, 1995; Terrell & Dringus, 2000; Wang et al., 2001).

It is obvious that all instruments have weakness and that, even though criticism has been directed toward the construct validity of the LSI (Geiger, Boyle & Pinto, 1992; Loo, 1996), but it is not the purpose for this study to design a new instrument. Taking into account of methodological problems, strengths and shortcomings of existing instruments, Kolb's Learning Style Inventory (1984, 1985) seems to be an appropriate instrument for this particular study for the following reasons:

- The instrument was tested on large samples; the normative group encompasses 1,993 persons with diverse background.
- The instrument is simple and short with 12 self-report items. This removes the overloading of students with too many demands over a short period of time.
- The instrument is grounded by Experiential Learning Theory as a theoretical framework to guide the application and implications of learning styles.

Research studies related to learning styles

The concept of learning styles helps students learn the course material and become aware of their thinking processes, and also assists them to develop interpersonal skills that are critical to success in any professional career. The array of research findings on student learning styles underscores a fundamental truth about teaching and learning, i.e., students learn in different ways (Mickler & Zipper, 1987; Price, 1983).

The use of knowledge about the learning styles of students can be examined from several perspectives. Claxton and Murrell (1978) suggest that the information of learning styles could be viewed at three levels of students, instructors, and institutions. From the standpoint of students, it is critical to contemplate their own learning strengths, weaknesses and preferences so that they are able to gain insights and improve how they learn. The acknowledgement of the limitations of their preferred learning styles serves the purpose of expanding their learning skills so they may become a well-rounded learner. According to Dixon (1985), when students become aware of their learning style type, they are capable of making informed decisions about the methodology and resources to best meet their learning needs. If students have the information about their learning preferences, they may take more responsibility for their own learning (Cohen, 1997).

From the standpoint of the instructors, learning style is being viewed as one way to expand teaching methods and curriculum to reach students, remove barriers to learning, and enhance student achievement (Anderson & Benjamin, 1994; Brant, 1990; Grasha, 1996; Sims & Sims, 1995). Furthermore, it is also considered a new way to conceptualize instruction and move the learning process from the instructor-directed approach toward a more learner-directed approach (Coron & Snow, 1986; Dixon, 1985; Mickler & Zipper, 1987; Whyte, Karolick & Taylor, 1996). Such a change coincides with constructivism in which the learner is viewed as an active participant rather than as a passive actor in the learning process. Price (1983) agreed that diagnosing learning styles of students assist educators to make better decisions about instruction and curriculum development as well as to aid in counseling individuals about problems, strengths, and opportunities which students may encounter in the learning process.

It is recommended to design courses which attempt to reach the full spectrum of learning styles of students. There is a growing need for using a variety of teaching approaches to reach students with diverse learning styles. According to Corno and Snow (1986), the success of education depends on adapting teaching to individual correlations among learners. It should be the instructor's goal to create a nurturing classroom environment for all students, and there must be an awareness that there are diverse learning styles within the student population. Variation of one's teaching approach is essential for maintaining student interest and meeting individual needs (Gunawardena & Boverie, 1993). This can be achieved by using a variety of teaching methods that are consistent with the styles of students, including group problem solving, brainstorming activities, design projects, and writing exercises in addition to formal lecturing (Dixon, 1985; Claxton & Murrell, 1978). Five instructional strategies are suggested by Dixon (1985) to incorporate learning styles into students' learning: a) helping individuals understand themselves as learners, b) encouraging individuals to expand their learning styles, c) using a variety of instructional approaches, d) creating an environment in which diversity can thrive, and e) creating a climate in which collaboration exists. In all, successful instruction will encourage and reinforce students' preferred style.

At the institutional level, the consideration of learning styles may be a complex and time-consuming process. The knowledge of learning styles is regarded as a framework for educational innovation and change. Administrative support is needed to permit the offer of alternative instructional approaches, and administrators should be aware of the roles they play in this organizational culture.

Learning Outcomes and Satisfaction

Satisfaction is associated with perceptions of being able to achieve success and to have positive feelings about the desired outcomes. Research always connects learner satisfaction with certain assessments measured by asking learners to rate their satisfaction with the overall learning experience (Billings & Cobb, 1992; Gunawardena & Boverie, 1993) Cookson, 1989). Cookson (1989) classified the possible student learning outcomes as:

1. Academic achievement: percentage of course assignments successfully completed, final course grade
2. Satisfaction with the course learning experience
3. Intention to enroll in additional distance education courses

An analysis of learning outcomes as measured by learner achievement (i.e. quizzes, projects, and final grades) and satisfaction are considered an important component in the effectiveness of a traditional course (Grasha, 1996). It would be interesting to study the impact of learning styles on learning outcomes and course satisfaction in either an online or blended version. This study will explore learning outcomes and satisfaction based on Cookson's classification, in particular academic achievement and satisfaction with the course learning experience. Thus, it would be meaningful to explore the notion of satisfaction and academic performance for the purpose of creating an effective learning environment either in traditional education, distance learning or blended learning (Johnson, Aragon, Shaik & Palma-Rivas, 1999).

Learning styles, learning outcomes and course satisfaction

The understanding of students' learning styles is important in both the learning and teaching process. The assessment of learning style opens the door to "a more personalized

approach to schooling, to student advisement and placement, to improvement of student skills, to successful instructional strategy and to meaningful evaluation of teaching and learning" (Keefe, 1979, p.2). Teachers and course designers should pay closer attention to students' learning styles by diagnosing, by encouraging students to reflect on learning styles, and by designing teaching materials to cater students' needs.

Brant (1990) and Matthews (1991) suggest that students become more motivated to learn by knowing their strengths and weaknesses as learners. Hankinson (2003) claimed that significant gains in student performance can be achieved "by just understanding the concept of student learning styles and having a personal learning style profile constructed" (p. 15). Academic achievement, creativity, productivity and satisfaction in the classroom were enhanced when students use their preferred style (Lenehan et al., 1994; Schmeck & Grove, 1979). McLoughlin (1999) provided a thorough review of the research literature on learning styles and outlined the ways learner styles might be integrated into the design of learning materials to ensure that learner needs and preference are accommodated. As a result, if teachers can align their teaching with students' strengths and weaknesses, then their academic performance and achievement are likely to increase and it is also more likely for students to develop effective learning strategies.

A wide variety of research study has shown that learning styles are related to academic performance (Gadzella, Stephens & Baloglu, 2002; Nulty & Barret, 1996; Matthews, 1991; Miller et al., 1987; Schmeck & Grove, 1979) and course satisfaction (Grasha, 1996; Price, 1983) in a traditional classroom setting. Learning improves when learning styles are taken into account. Most researchers agree that achievement and satisfaction are improved when students use their preferred learning styles (Lenchan et al.,

1994; Miller et al., 1987). Students demonstrate statistically higher achievement and test scores. They retain what they learn longer when taught through their perceptual strengths. Learning may be more effective and efficient (Partridge, 1983), and there is less anxiety (Hankinson, 2003; Nulty & Barrett, 1996) and increased school retention (Johnson et al., 1999).

Some research focused on a comparison of teaching styles and learning styles using the learning style inventory (Laplan & Kies, 1995; Wallace, 1995). These studies suggest that students learn best when their learning styles matches the teaching style of the instructor. However, much of the research does not support these claims of matching learning styles into the teaching process (Ford & Chen, 2001; Stellwagen, 2001). These studies did not find that students' learning styles contribute to academic achievement, creativity, productivity, and satisfaction in the classroom.

Learning Styles in Distance Education

Distance education is a form of education characterized by the physical separation of teacher and student in time and space (Holmberg, 1986; Palloff & Pratt, 2003; Picciano, 2001). The terms, distance education and distance learning have been used interchangeably in the research. Essentially they mean the same thing with varied focuses. With the many current technologies available, various forms of distance education have provided learning opportunities for students who would be otherwise unable to attend classes.

The effectiveness of distance education may be assessed by three broad measures, according to (Merisotis & Phipps, 1999):

- Student outcomes, such as grades and test scores
- Student attitudes about learning through distance education

- Overall student satisfaction toward distance learning

Like traditional education, distance education is a dynamic and complex interaction of learner, content, setting, instruction and outcome (Billings & Cobb, 1992; Carnevale, Olsen, 2003). Learning outcomes and learner satisfaction are important factors to deliver an effective and efficient distance education program. The relationships among these variables are critical when delivery methods are changed to cater to students at a distance. Gaining knowledge about learning styles of distant students helps educators make informed decisions about online course development and implementation.

The research surrounding learning styles in distance learning is diverse; originating form physical models, cognitive issues, and psychological or emotional aspects of an individual's learning style (Dunn & Griggs, 2000; James & Gardner, 1995; Lin, 1996; Schellens & Valcke, 2000). Little is known about the effects of learning style preference on learning outcome, including academic achievement and learner satisfaction in distance learning (Cookson, 1989; Shin & Gamon, 1999; Wang, Hinn and Kanfer,2001). Some studies have not found significant relationships among learning styles, learning outcome and satisfaction with distance learning (Larsen, 1992; Shin & Gamon, 1999; Wang et al., 2001). Larsen (1992) found no significant relationship between learning style groups and suggested that both effectiveness and satisfaction were independent of students' learning style preference. Shih and Gamon (1999) found that student learning styles and student characteristics did not have an effect on their Web-based learning achievement. They also concluded that students with different learning styles did not affect student motivation and use of learning strategies. Wang et al. (2001) found no changes in student learning styles and

no significant correlation in learning outcomes and learner satisfaction with regard to different learning styles.

However, some researchers suggest that students' learning styles influence learning outcomes, and that learning styles have a direct impact on student performance in a distance learning environment (Billings & Cobb 1992; Gee, 1990). Gee (1990) studied the effects of students' preferred learning styles on perceived individual academic achievement, attitudes toward the learning environment, and course completion rates in graduate distance education courses at Texas Tech University. She suggested that learning styles may affect academic achievement and attitude of students involved in distance education settings, thereby replicating the results of studies of students in traditional classroom settings.

A number of research studies compared the distance learning environment with the traditional instruction and found no significant differences among learning styles, learning outcomes and course satisfaction (Allen et al., 2002; Dexter, 1995; Neuhauser, 2002). Students' performance and satisfaction level might not change much when the learning environment is switched to an online format. Allen et al. (2002) note that the replacement or substitute of traditional face-to-face education with distance education should demonstrate little decline in student satisfaction with the quality of the educational process. Dexter (1995) found that there was no significant difference in the performance outcomes between the on-campus and off-campus students. Neuhauser (2002) compared two sections of the same course – one section was online and asynchronous; the other was face-to-face – by examining gender, age, learning styles, course effectiveness, and final grades. The results revealed no significant differences in final grades, course effectiveness, and learning styles.

Concerning the relationship of Kolb's learning style with learning outcomes and course satisfaction in distance learning, some researchers have found that there was significant relationship between learning style, learning outcomes and satisfaction in traditional education and distance learning (Billings & Cobb, 1992; Gee, 1990; Kevin & Liberty, 1975). Learner characteristics such as a student's preferred learning style are a major factor in performance and satisfaction levels of the distance learner and should influence how the course is designed (Merisotis & Phipps, 1999). Kevin and Liberty (1975) indicated that the abstract conceptualization (AC) scale of the Learning Style Inventory varied positively with course grade. Learners with this learning mode (Assimilator and Converger) performed better than Accommodator and Diverger. The pattern is consistent with the description of the AC scale described by Kolb (Kolb, 1984), which stresses an intellectual or analytical approach to learning. College students, particularly those majoring in scientific fields, might be expected to be analytical skilled to be successful in an online course.

Similar research results were found in Dille and Mezack (1991), Diaz and Cartnal (1999), Gunawardena & Boverie (1993), Terrell (1995), and Terrell and Dringus (2000). Dille and Mezack (1991) used Kolb's Learning Style Inventory (LSI) to determine style correlation between successful students and unsuccessful students. Successful students had higher scores on the AC-CE (Abstract-Conceptualization, Concrete Experience) scale indicating that students with a less concrete style are better suited to the telecourse learning. This means that students who preferred abstract analyses did much better than those with higher scores in concrete experience. Diaz and Cartnal (1999) suggest that students with less need for concrete experience in learning may be expected to perform better and thus be better suited to the distance format. Gunawardena & Boverie (1993) examined the interaction of

adult learning styles and the media, methods of instruction, and found that Accommodators, Convergers and Assimilators in the distance class were much satisfied with the overall learning experience. Terrell and Dringus (2000) studied the correlation between learning styles and student drop-out rates. They found that Kolb's Convergers and Assimilators categories were predicators of success in the graduate degree program. Terrell (1995) also predicted that students taking computer-mediated coursework would primarily be Convergers and Assimilators. Terrell's findings indicated that 73.3 percent of students' learning styles were those of either Convergers or Assimilators. Therefore, it can be postulated that Convergers and Assimilators might be more comfortable with distance learning than other students with other learning styles.

Many published articles (Dixon, 1985; Hackman & Walker, 1990; Schellens & Valcke, 2000) indicate that in order to accommodate various learning styles in the online classroom, different types of assignments and approaches to learning might achieve this objective. For example, if instructors use simulations, case studies, collaborative group projects, these will help them broaden the learning experience and accommodate various learning styles. It is the instructor's responsibility to create a course that is varied in its approaches and helps to motivate all students and keep them involved. Dixon (1985) claims that the learning style information should be assigned to the learner; however, the instructors' assistance is also needed. In the same vein, Lynch (2002) thinks that it is "a shared responsibility for learning between the instructor and the student" (p.16) in distance learning. The instructor is responsible for utilizing a variety of styles, such as graphics, text, and various multimedia materials to cater to individual learners, at the same time challenging and further developing their weak learning modes.

More importantly, it is a good thing for students to identify and recognize their learning style type and adapt the learning style to the web-based learning environment. McVay (2000) states that student learning abilities and success rate in course completion improved when students demonstrated the ability to utilize their preferred learning styles and make adjustment as needed to accommodate their needs in a distance learning environment. Therefore, addressing a variety of learning styles is equally important both in distance learning, and in a traditional classroom (Lynch, 2002).

Learning Styles in Blended Learning

Blended learning is not a new concept in education, and it evolves from e-learning to embrace multiple dimensions and to coexist with distance learning (French et al., 2003; Thorne, 2003). Blended learning emerges as an alternative form of delivery medium via the application of varying levels of technology employed in the course (Singh, 2003). A blended learning experience combines offline and online forms of learning where the online learning usually takes place over the Internet or Intranet, and offline learning usually occurs in a traditional classroom setting.

Thorne (2003) claims that blended learning is a mix of multimedia technology: CD ROM video streaming, virtual classroom, voicemail, email and conference calls, online text, animation and video-streaming. He describes blended learning as follows:

> Blended learning is the most logical and natural evolution of our learning agenda. It suggests an elegant solution to the challenges of tailoring learning and development to the needs of individuals. It represents an opportunity to integrate the innovative and technological advances offered by online learning with the interaction and participation offered in the best of traditional learning. It can be supported and enhanced by using the wisdom and one-to-one contact of personal coaches (p.16).

Blended learning, blended courses, mixed model or combined course (Zhao, Lei, Yan, & Tan, in press) are some terms used to indicate that part of instruction is conducted face-to-face, while the rest is delivered via computer-mediated technologies. This study chose the term of blended learning to mean a combination of online lecture and face-to-face on site lab. Literature suggests that some face-to-face personal contact is necessary and critical to maintain student motivation, to establish a learning community and thus to ensure high quality of education (Osguthorpe & Graham, 2003; Whyte et al., 1995).

It is known that face-to-face learning provides a learning environment for social interaction among the learners. Although online learning creates an interactive and adaptive learning environment mediated via asynchronous and synchronous communication tools, it can never replace the need for interaction and collaboration in a traditional classroom. Researchers argue that purely distance delivery systems limit interaction among students and teachers, whereas blended environments enhance the possibilities for such interaction both in class and online format. This is one reason why blended learning is blooming in recent years. The evidence indicates that blended learning not only offers more choices of delivery modes but also is more effective. Thorne (2003) states that blended learning should be the ultimate solution to tailoring learning to fit not only the learning need, but also the style of the learner. Thorne (2003) predicted that blended learning could continue to develop into the future of online learning.

Blended learning allows multiple delivery media to complement one another and promote effective learning (Singh, 2003). Organizations often need to use a blend of learning approaches to get the right content in the right format to the right people at the right time to maximize high return on investment. Instructors often adopt blended approaches based on the

idea of inherent benefits in both face-to-face and distance learning environments, seeking balance and harmony between the two methodologies. As a result, instructors and course designers must pay attention to appropriate pedagogy and instructional strategies that are tailored specifically to improve student learning. Osguthorpe and Graham (2003) proposed six achieving goals to design blended environments: a) pedagogical richness; b) access to knowledge; c) social interaction; d)personal agency; e)cost effectiveness; and f) ease of revision. The pedagogical dimension stresses the importance of what needs to be delivered and what the learner needs in the learning process. It creates an opportunity for instructors to encompass different instructional strategies.

Zhao et al. (in press) did a meta-analysis on the effectiveness of distance education. They found that a combination of technology and face-to-face education yielded most positive outcomes, proving that blended courses can play a key role in education. Recent research supports a blended model of distance education that combines both a face-to-face and technology-mediated component as complements to each other (Smith, 2001; Parkinson et al., 2003).

Schwab (1983) characterizes education as four common entities – teacher, student, what is taught, and the milieux of teaching –learning. Teacher, student and content stay the same in face-to-face education and distance education, while the milieux of teaching-learning varies due to formats and methods of delivery through various kinds of technology. Thus, Schwab's classification may serve as a general framework for understanding blended learning as well.

No empirical studies have been found to explore the relationship of learning styles on learning outcomes and course satisfaction in the context of blended learning. One study of

comparing a traditional class and a blended course showed relationship in terms of student satisfaction, learning preferences and learning outcomes due to the changes of delivery modes (Parkinson et al., 2003). Since blended learning is a preferable way to combine technology and traditional classroom together, the research findings of learning styles in distance learning literature discussed previously are applicable to a blended learning environment, which is the context of this research study to investigate relationships among learning styles, learning outcomes and course satisfaction.

Summary

The objective of this study is to examine how learning styles are related to learning outcomes and course satisfaction in a blended course. This chapter has presented a literature review concerning the following topics: learning styles, learning outcomes and satisfaction, learning styles in distance education, and learning styles in blended learning. Kolb's Experiential Learning Theory and Learning Style Inventory were reviewed as the theoretical foundation and instrument to be used in this study. The literature has not reached a consensus that learning style is a critical factor to influence the teaching and learning process no matter whether such process takes place in traditional education or distance education. Numerous studies on learning styles exist; however, research on distance education and learning styles show discrepancies. Strong empirical studies are needed to support and stress the relationship among learning styles, learning outcomes and satisfaction in a blended learning environment to enhance effective learning. The current situation led to the focus of this research study, and this study hopes to provide useful information on effective learning in a blended course.

CHAPTER 3. METHODOLOGY

This chapter provides the methodology for this study. The purpose of the study is to investigate relationships among learning styles, learning outcomes and course satisfaction in a blended course. This chapter is structured in the following sections: a) background; b) the course: Com S 103; c) the researcher; d) population and sample for this study; e) research design; f) research procedures; and g) summary.

Background

WebCT, a class management tool, is gaining much popularity as a new medium of distance education delivery mode. Instructors can create a password-restricted course website to deliver course materials and can communicate with students asynchronously or synchronously. Iowa State University has a site license agreement with WebCT and provides technical support on campus to assist faculty, staff and students using WebCT. WebCT is becoming a popular tool with the increasing numbers of WebCT courses being offered each semester at Iowa State University. The technical staff (personal communication, November 16, 2004) from Center for Excellence for Learning and Teaching (CELT) at Iowa State University reported that as of fall semester of 2004, there are 56,532 WebCT users from the University Extension/Outreach and eight colleges including Agriculture, Business, Design, Education, Engineering, Family and Consumer Sciences, Liberal Arts and Sciences, and Veterinary Medicine. There are 30,218 unique student NetIDs enrolled in 1,687 active WebCT courses and 6,784 students are enrolled in multiple WebCT courses. This number is expected to continue to grow.

There are three major uses of WebCT on the campus. First, the entire course goes online in WebCT, in which instructors and students do not have to meet face-to-face.

Lectures, interaction, and participation are handled in a virtual learning environment. Second, the course moves partially online, and students attend a few sessions of the class face-to-face. A blended model is adopted and the allocation of time between face-to-face and virtual meetings is designed by the instructor. Some instructors divide the time 50/50 equally, some prefer to 20% of face-to-face meeting time and 80% of virtual class, or verse versa. In the third offering, the class meets face-to-face every week for lectures, tests and labs. The WebCT course site is used as a supplement for the actual course. Students use it to access grades, announcements, and lecture notes, but communication and interaction are seldom seen in those cases.

The Course: Com S 103

Com S 103 is an introductory microcomputer literacy course open to all students with little or no prior computer experience offered by the Computer Science department at Iowa State University. It is a 4-credit course offered in regular spring and fall semesters plus summer. As technology expands and grows dramatically, computer knowledge and skills become essential for undergraduate students to assist in their learning and enhancement of their future career. This course is required at Iowa State University for several non-computing undergraduate programs, including Physics, Chemistry, Management Information Systems, Accounting and Biology. These programs require students to be equipped with basic computer skills, such as word processing, spreadsheet analysis, and data management.

Earlier versions of this course were offered traditionally with a mix of face-to-face lectures and lab sections. Cost-cutting considerations led the administration to offer the lectures online. The first online lecture version was offered in the spring semester of 2001 (January - May). There were two instructors for 800 students enrolled. The students also

attended a two-hour lab each week where they worked through tutorials on various computer applications. There were 20 students in each lab led and monitored by two teaching assistants.

In the summer session of 2004, Com S 103 was delivered with both face-to-face lab practice and WebCT online lecture. The WebCT course site was comprised of six major elements: announcement (class news, assignment/quiz reminder), course information (syllabus, course schedule), lab information (lab schedule, Help Desk information), course content (lecture notes for 15 chapters), assignment (weekly quizzes, lab assignments), communication tools (WebCT email, discussion forum and chat room), and resources (*Discovering Computers 20004* - the textbook website, *SAM/TOM* – training and assessment software). Additionally, students could access their grades to see their progress in this course.

Two major components formed the course content: computer literacy and computer applications aimed to develop and enhance students' computer skills. The literacy component was covered in weekly reading assignments and WebCT was used as an online learning environment for all course information and communication. Table 3 lists the course content and the week in which the literacy topics were covered during the summer session of 2004. The applications part was covered in a weekly two-hour lab with some practical activities and assignments. Students used application software including Microsoft Office XP to practice Word, Excel, Access and PowerPoint to develop and demonstrate basic computer skills.

Table 3. Com S 103 Course Content Outline

Course content	Week
Computer components	Week 1
Computer hardware	Week 2
Types of computer software	Week 3
Operating systems and utility programs	Week 4
Communications and networks	Week 5
Information management	Week 6
Systems development	Week 7
Programming languages	Week 7
Security, privacy and ethical issues	Week 8
e-Commerce and future of computer technology	Week 8

Note: From Com S 103 syllabus (summer, 2004)

During the summer session of 2004, 95 students enrolled in this course. Students were divided into five lab sessions and were required to attend a weekly lab twice a week. Three teaching assistants assigned by the Department of Computer Science facilitated and monitored these five lab sections.

The Researcher

Since qualitative research approach was used in one part of this research study and it is said that qualitative research is influenced by the researcher's perspectives (Merriam, 1988; Patton, 1980), it is helpful to share the background and experience of the researcher with readers for a deep and clear understanding of this study. This section is a brief description of the background and experience of the researcher.

The researcher got her undergraduate degree on Management Information Systems from a Midwest university prior to entering the graduate program of Curriculum and Instructional Technology. A passion for teaching and technology inspired her to study in the Curriculum and Instructional Technology program to broaden her general knowledge of education and the role technology plays in education. The manner in which technology integration affects the teaching and learning process and curriculum development remains a

core interest for the researcher. She still remembered a couple of courses during her first semester in the Curriculum and Instructional Technology program. The instructor introduced various kinds of software packages such as Hyper Studio, Kids Pix Deluxe and Inspiration for educational purposes, and asked the class to come up with ideas and thoughts on how to use these software packages in the classroom. She was very impressed by the effective use of technology as an interesting and meaningful tool to enhance student learning. Later, she took a course on principles and practices of distance education and this course gave her a thorough understanding of distance education and served as a theoretical foundation of the present study on the investigation of learning styles in the context of blended learning. From that earlier course, she realized that distance learning brings learners benefits, such as flexibility, convenience, and extended learning opportunities, while at the same time, potentially raising new barriers and challenges.

The researcher first studied Com S 103 in a graduate course on distance education. In that course, Com S 103 was used as a case study to analyze the implementation of distance learning in higher education as well as the benefits and challenges of distance learning. The large enrollment of 800 students during spring and fall semesters each year brought interesting challenges to the case study. The topic of students' learning styles in the context of blended learning was chosen for this research study. The researcher attempted to explore how the concept of learning style impacts student learning, in particular, learning outcomes and satisfaction with this online and F2F (face-to-face) combined course and hoped to get some interesting results from this study.

From the researcher's previous work experience in China as an ESL (English as a Second Language) teacher, she had knowledge of students who learn at different paces with a

range of strategies. A key element in getting students actively involved in the learning process lies in an understanding of their learning style preferences, which positively or negatively impact student performance. A traditional delivery mode such as classroom instruction might not work well for all students. The researcher has developed a view of the need to motivate all students engaged in their learning, this need becoming crucial for both online learning and blended learning. This led to the study of investigating the relationship among learning styles, learning outcomes and course satisfaction in a blended course.

Population and Sample for this Study

There were 95 students enrolled in the Com S 103 course during the summer session of 2004. These students came from a range of departments encompassing seven colleges at Iowa State University. The colleges included: Agriculture, Business, Design, Education, Engineering, Family and Consumer Sciences, and Liberal Arts and Sciences. A total of 71 students (75%) signed the informed consent form and volunteered to participate in the study. Participants included freshmen, sophomores, juniors, seniors and special degree students who sought enhanced computer skills for their own interests. Seventy-one (75%) students completed the Kolb's LSI (Learning Style Inventory). Eighty-three (87%) students enrolled in this course finished the online survey during the finals week posted at the Com S 103 WebCT site. The researcher attempted to employ data from participants who completed both the Kolb's LSI and the survey in order to explore the relationships among learning styles, learning outcomes and course satisfaction. In fact, there were 59 participants who met the criterion for data selection. Four participants selected to represent Accommodator, Assimilator, Converger and Diverger as defined by Kolb were interviewed individually to

provide an in-depth understanding of learning styles from students' perspectives. These data were considered to be the responding sample of this study.

Research Design

This study involves both quantitative and qualitative methods. It used statistical analysis and qualitative analysis from interviews to explore the potential relationship among learning styles, learning outcomes, and course satisfaction in the Com S 103 course.

Quantitative research relies on numbers to organize and analyze data. According to McMillan and Schumacher (2001), descriptive statistics and inferential statistics transform a set of numbers or observation into indicators that describe or characterize the data. The use of statistics is the most fundamental way to summarize data, and it is indispensable in interpreting the results of quantitative research. Descriptive analysis and inferential statistics are used in this study to show the distribution of learning styles in the research sample, the relationships among learning styles, learning outcomes and course satisfaction.

The study used an additional qualitative research method for two reasons. First, qualitative method is appropriate for disclosing attitudes, thoughts and perceptions on a particular phenomenon about which further research might be needed. It is a qualitative investigation of one person, group, event, or setting over a single time period as explained by McMillan and Schumacher (2001). Second, a detailed description of the research context is needed in order to provide a complete picture of what is going on (Patton, 1980). While statistics data focus on a set of numbers for summary and analysis of data, a case description using interview data is chosen as another way of looking at the relationship among learning styles, learning outcomes and course satisfaction with the focus of in-depth analysis of words rather than numbers.

According to Merriam (1988), the decision about which research design to use depends upon the nature of the research questions, the amount of control, and the desired end product. This research study sought to understand the relationships among learning styles, learning outcomes and course satisfaction in a blended learning environment. The understanding of these relationships from the angle of students is important. Patton (1980) states that "we interview people to find out from them those things we cannot directly observe. The purpose of interviewing them is to allow us enter into the other person's perspective (p.196)." Thus, interviewing is a tool of qualitative case study research used in this study to acquire unique information on the participants' views, beliefs, and feelings (Merriam, 1988). Student interview data were gathered as the original analysis source in order to reveal the potential relationship among learning styles, learning outcomes and course satisfaction.

Research Procedures

In May 2004, the researcher submitted a research application to the Human Subjects Committee at Iowa State University (Appendix A). The researcher procedures and instruments were reviewed and approved by the committee. The study adopted Kolb's Learning Style Inventory, a well-established learning style inventory as one instrument with which to diagnose the learning style of each participant. Since this instrument is copyrighted, the researcher contacted Hay Group (http://www.haygroup.com), an organization which handles Kolb's LSI license and copyright, and requested permission to use this instrument in this study. An approval letter from Hay Group was included in Appendix C. Kolb's Learning Style Inventory (LSI) of the 12-item questionnaire and LSI profile for scoring sheets in a PDF format were sent to the researcher via email attachments in June 2004 (Appendix D).

An online survey (Appendix E) developed by the instructor of Com S 103 and extended by the researcher was used as another instrument for the relation analysis of learning outcomes and course satisfaction with learning styles. The interview was designed in a semi-structured form and intended to seek input for in-depth understanding of learning styles in a blended learning environment from the students' perspectives. The interview questions are included in Appendix F. Interviews were conducted individually with four participants selected to represent Kolb's four learning style types. All of the interviews were tape-recorded with the consent of the participants. Then, the interview was transcribed and emergent themes of learning styles were recognized.

Study instruments

The research design for this study involved the use of two instruments: Kolb's Learning Style Inventory (LSI) with the permission from Hay Group and an online survey posted in the WebCT course site by the instructor of Com S 103.

Kolb's Learning Style Inventory

Kolb's Learning Style Inventory (LSI) is a self-descriptive and self-reporting instrument designed to measure learning preferences on two bipolar dimensions based on the Experiential Learning theory proposed by Kolb (1984): Concrete Experience (CE)/Abstract Conceptualization (AC), and Active Experimentation (AE)/Reflective Observation (RO). The inventory has 12 items, participants need to rank order (1=least like you, 2=third most like you, 3=third most like you, 4=most like you) of the sentence completion endings according to the scale of which ending characterizes their preferred learning styles, for example, when I learn, ____: A. I am happy. B. I am fast. C. I am logical. D. I am careful. Each choice indicates different learning modes described by Kolb' Experiential Learning

Theory, respectively, CE (Concrete Experience) characterized by the word "feeling", RO (Reflective Observation), "watching", AC (Abstract Conceptualization), "thinking", or AC (Active Experimentation), "doing".

The location of the combined scores (AC-CE and AE-RO) on the Learning Style Type Grid (Appendix D) identifies each learner's preferred learning style as Converger, Diverger, Assimilator, or Accommodator (Kolb, 1984, 1985). The closer the data points are to the center of the grid, the more balanced the learning style (Kolb, 1984, 1985), and this indicates that the learner uses different styles together as needed (Kolb, 1984, 1985). If the data points fall near any of the far corners of the grid, the learner tends to rely heavily on that particular style (Kolb, 1984, 1985).

Online survey

The survey posted in the Com S 103 WebCT site was primarily designed by the instructor of Com S 103 to get student feedback. It contained 43 questions about course structure, technology, communication and interaction, assessment, and overall satisfaction of the course. There were two open-ended questions (Question 42, and 43) for comments and suggestions. The researcher added four questions (Question 20, 32, 33 and 34) to the survey in order to get students' comments on the learning materials, technical support, and attitude of using multimedia. A copy of this online survey is included in Appendix E.

Demographic information was collected on the participants from the survey. The survey asked questions (Question 4, 5, 6, 7, 8, 9, and 10) about the participants' gender, age, college major, academic classification (freshman, sophomore, junior, senior or non-degree) and experience with web-based courses. These demographic data served as background information to study learning styles in this blended course.

Sixteen questions (Question 3, 11, 14, 15, 18, 21, 22, 23, 24, 25, 26, 28, 29, 30, 31, and 40) were selected by the researcher to examine course satisfaction in terms of general feelings, communication and interaction, course organization and structure, assessment, and weekly lab with respect to learning styles. The questions used the Likert-type scale for assessment: a = Strongly Agree, b= Agree, c = Neutral, d = Disagree and e= Strongly Disagree. For statistical purposes, this scale was changed into 1= Strongly Agree, 2= Agree, 3 = Neutral, 4 = Disagree, and 5= Strongly Disagree to study mean scores, standard deviations, and correlations of learning styles with learning outcomes and course satisfaction.

Data collection

This study involved two research methods: quantitative and qualitative analyses. The sources of qualitative analysis mainly come from interviews of four participants with different learning styles. The sources of quantitative analysis come from Kolb's Learning Style Inventory, the online survey and final grades of participants in Com S 103.

Quantitative data

The researcher attended the second session of the lab of Com S 103 in Week 1, passed around the informed consent forms, and described the research procedures and participants' confidential rights. For a full copy of informed consent forms, see Appendix B. Participants were assured that their responses were confidential and anonymous. The researcher gathered 71 signed informed consent forms indicating that they were willing to participate in Kolb's LSI (Learning Style Inventory) and an online survey. After gathering these informed consent forms, the researcher administered and collected the LSI in five lab sessions. Participants who completed the LSI were advised that the purpose of the inventory was to assess individual skills in learning from experience. They were also instructed that

there was no right or wrong answer and that all learning preferences are equally valuable. It took participants 10-15 minutes to complete the LSI.

Upon the completion of the LSI, the researcher collected the LSI from participants and calculated each participant's score of CE (Concrete Experience), RO (Reflective Observation), AC (Abstract Conceptualization) and AE (Active Experimentation). Two combination scores from AC-CE and AE-RO were employed to plot the data interception on the two bipolar dimensions of the Learning Style Type Grid (Appendix D). A particular learning style type is located on the grid.

When distributing the LSI questionnaire to participants, the researcher recorded a unique number on each LSI and recorded this number with the corresponding student, so later the researcher would be able to associate their LSI scores with responses gathered from the online survey. This number was then entered into the WebCT course site as the participant's research ID. This procedure also assured each participant's anonymity.

It took participants approximately 15-20 minutes to complete the survey. The survey was conducted as an option for the instructor to gather inputs from students to improve this course. Participants were offered a bonus of five points towards their final grades. They were asked to first enter their research ID numbers in the survey in order to find the corresponding participants who both participated in the LSI and online survey.

There were 71 participants in the LSI and 83 participants in the survey. Some of participants forgot to enter their research ID in the survey, some did not follow the instruction and used their campus ID instead, and others who completed the survey did not participate in the LSI. Therefore, 59 participants were left as the valid sample with which to

study the relationship among learning styles, learning outcomes and satisfaction in this blended course.

Final grades of participants in Com S 103 obtained from WebCT course site were used as an indicator to determine the correlation between learning styles and learning outcomes of participants.

Qualitative data

The qualitative data in the study came from four interviews. These interviews followed a semi-structured format (Appendix F). The four interviewees were chosen as a representative of each learning style, respectively, Diverger, Assmilator, Converger, and Accommodator based on their scores of Kolb's LSI. The researcher attempted to get additional data and seek the students' perspectives of learning styles and satisfaction of the course, how they viewed online/ blended learning, and what roles the lab sessions played.

Two weeks after the completion of Kolb's LSI, an email was sent out to four participants asking for a follow-up interview. In the email, the researcher described what the interview would be about and requested a meeting time for the interview. The interviews were conducted individually and audio-taped with each interview lasting 30-40 minutes. Before the interview, each participant was asked to sign a participating form agreeing to collect interview data (Appendix B). In the interview, the researcher started with a basic set of questions but was not bound by the order and added questions as needed (Merriam, 1988). Each interview lasted about 30-40 minutes, and was conducted in an informal conversational manner. All of the interviews were tape-recorded with the consent of the participants as specified in the informed consent forms. Interview data were transcribed precisely and coded inductively. The researcher also took notes during the interviews to highlight key

information. The similar patterns were outlined, and later they were used as emergent themes to determine the correlation of learning styles, learning outcomes and course satisfaction from students' perspectives, if any.

Data analysis

The Statistical Package for the Social Sciences (SPSS; version 12.0) for Windows and Microsoft Excel 2003 were used for statistical analysis. Learning styles as an independent variable was used in these analyses. The dependent variables included final grades, satisfaction as measured by general feelings, communication and interaction, course organization and structure, assessment and weekly lab. A standard convention level of <0.05 was used for evaluating significant relationship.

The procedure of quantitative data analysis in this study was as follows:

1. Report the distribution of four learning styles of the entire sample (N=59) including frequencies and percentages of Accommodator, Assimilator, Converger and Diverger.
2. Describe the sample and demographic statistics including academic classification, college of the major, gender, age, and employment. The analysis was completed using SPSS frequencies, percentages, mean scores and standard deviations. The purpose was to provide background information of the participants.
3. Report any significant relationship ($p< 0.05$) between learning styles and learning outcomes as measured by final grades from one–way ANOVA analysis in SPSS.
4. Seek any significant relationship ($p< 0.05$) between learning styles and course satisfaction from one-way ANOVA analysis. If there was any significant relationship, mean scores and standard deviations were then used to show the

higher level of course satisfaction associated with a particular learning style, i.e., whether Accommodator, Assimilator, Converger or Diverger is most satisfied or least satisfied with this blended course.

From these analyses, the researcher attempted to study the relationships among the learning styles, learning outcomes and satisfaction in Com S 103. The results are reported in Chapter four and five of this study.

As to the analysis of interview data, the data were transcribed precisely and coded inductively. Similar patterns were outlined and emergent themes were identified to indicate the relationship among learning styles, learning outcomes and course satisfaction. Data gathered from the individual interview went through member checking to ensure appropriate interpretation of the collected data. It is ethical to do member checking. This process involves taking the data and interpretations back to the participants who provided the data to check with them to see if the results are reported accurately and realistically without any bias (Merriam, 1988). After the data analysis, the researcher shared the data and findings with the research participants, asked for comments and suggestions, and made revisions accordingly.

Summary

The purpose of this chapter was to describe the methodology used in exploring the relationships among learning styles, learning outcomes and course satisfaction in Com S 103 as a blended course offered at Iowa State University. The chapter included a description of the methods and procedures for this study. The research design was explained. The data collection and planning for the data analysis were also presented.

Quantitative data and interview data were used in this study to examine the relationship among learning styles, learning outcomes and course satisfaction in a blended

learning environment. Data were gathered from multiple sources: Kolb's Learning Style Inventory, online survey, final grades of the participants and four interviews. These data were analyzed using SPSS and Microsoft Excel to answer the following research questions: What, if any, relationship exists between learning styles and learning outcomes? What, if any, relationship exists between learning styles and course satisfaction? What, if any, relationship exists between learning styles and student performance? Analysis of quantitative data included descriptive and inferential statistics such as means, frequencies, standard deviations and one-way ANOVA analysis to examine the relationship among learning styles, learning outcomes and course satisfaction. The analysis from interview data provided in-depth views and thoughts of learning styles, learning outcomes and course satisfaction in a blended learning environment from students' perspectives. The results and findings of the study will be reported in the next chapter.

CHAPTER 4. RESULTS AND FINDINGS

The purpose of the study was to investigate the relationships among learning styles, learning outcomes and course satisfaction in Com S 103 as a blended course. The objectives of the study were to identify:

a) demographic characteristics of the participants,

b) how learning outcomes and course satisfaction differed in relation to students' learning styles,

c) how participants viewed their learning styles in a blended learning environment.

The data are organized into the following sections: a) demographic data; b) tests for learning outcomes and learning styles; c) tests for course satisfaction and learning styles; d) students' perspectives on learning styles, learning outcomes and course satisfaction; and e) summary.

Demographic Data

The first task of the survey (for a full copy of the survey, see Appendix C) was to obtain descriptive background information about participants. The particular demographic information gathered about the participants was that of academic classification, college, age, gender and employment. The instructor assisted with the interpretation of this data.

The overall distribution of participants' learning styles in Com S 103 is shown in Table 4. The table illustrates frequencies and percentages of four learning styles as measured by Kolb's Learning Style Inventory. There were 14 Accommodators (23.7%), 19 Assimilators (32.2%), 13 Convergers (22.2%), and 13 Divergers (22.2%). No particular learning style occupied a majority position. Based on the research of Kolb (1984, 1993), this is a normal distribution of four learning styles with an emphasis on Concrete Experience

(feeling), Reflective Observation (reflecting), Abstract Conceptualization (thinking), and Active Experimentation (doing). In regard to career fields, Kolb states that learners in natural science fields should most naturally be characterized as Convergers or Assimilators, since RO and AC tend to be their preferred learning modes. Social science majors are most likely to be categorized as Assimilators. Business majors in the work force are categorized as either Divergers or Assimilators. In the career fields relating to the humanities, the preferred learning style based on Kolb's research is the Diverger. One question (Question 8, Appendix E) in the survey was related to the college of the major, but not enough information could be obtained with which to compare learning styles across academic majors in this study by applying Kolb's findings.

Table 4. Frequency and Percentage of Learning Styles

Learning Styles	N	%
Accommodator	14	23.7
Assimilator	19	32.2
Converger	13	22.0
Diverger	13	22.0
Total	59	100

Table 5 shows the distribution of participants' academic classification and college of major. Thirty participants (51%) were juniors, twelve participants (20%) were seniors, eleven participants (19%) were sophomores, and three participants (5%) were freshmen. The Other classification (5%) includes 3 high school students, non-degree students, and graduate students. This distribution of the participants' academic classification was not typical for an entry-level computer literacy course, according to the instructor. There should be a large majority of freshmen and sophomores taking this course instead of juniors and seniors. The instructor mentioned multiple reasons for this unusual distribution of the summer class. The

course tended to quickly fill up during Spring and Fall semesters, so many students had to wait for a later time. Some of students retook the course because they dropped, failed, or wanted to try for a better grade, and they found it most convenient to retake the class offered during the summer session. Some of juniors and seniors were already familiar with Microsoft Office tools, the collections of computer applications practiced in the lab prior to taking this class and they may have taken it expecting an easy course to complement a difficult summer course.

Table 5 Academic Classification and College Distribution

Variable	Total	
	N	%
Academic Classification		
Freshman	3	5
Sophomore	11	19
Junior	30	51
Senior	12	20
Other	3	5
Total	59	100
College		
Agriculture	7	12
Business	22	37
Design	1	2
Education	7	12
Engineering	2	3
Family & Consumer Sciences	7	12
Liberal Arts & Sciences	10	17
Other	3	6
Total	59	100

Table 5 also shows that twenty two participants came from the College of Business (37%), with the rest consisting of ten participants from the College of Liberal Arts and Sciences (17%), seven participants from the College of Agriculture (12%), seven participants from the College of Education (12%), seven participants from the College of Family and Consumer Sciences (12%), two participants from the College of Engineering (3%), and one

participant from the College of Design (2%). Three participants (6 %) had not declared their majors yet. The instructor noted that the number of participants from the College of Business was larger than those from other colleges, and also noted that the College of Business requires a GPA of 3.0 or higher to move from a pre-business major to a business major. Some of the participants probably retook the course to try to meet the college requirement.

Table 6 shows the gender, age and employment distribution of the participants. There were 32 male participants (54%) and 27 female participants (46%). The percentage for the male and female did not vary much with the divisions of four learning styles. There were 48 participants (81%) whose ages fell between 18 and 22 years old. Eight participants (14%) were between 23-29 years old, two participants (3%) were 30-39 years old, and one participant (2%) was less than 18 years old. None of the participants (0%) fell into the age group of 40-49 years old or greater than 50 years old. The result displays a typical age range between 18-22 years-old for undergraduate students.

As to the employment, twenty five participants (42%) had 20-30 hours per week part-time jobs, thirteen participants (22%) had 10-20 hours per week part-time jobs, ten participants (17%) had a full-time job, nine participants (15%) were unemployed, and two participants (3%) had part-time jobs of less than10 hours a week. The data indicates that most of the participants had full-time or part-time jobs. They were busy handling both school and work.

Table 6. Gender, Age, Employment and Reasons for Taking Com S 103

Variable	Total	
	N	%
Gender		
Male	32	54
Female	27	46
Total	59	100
Age		
<18	1	2
18-22	48	81
23-29	8	14
30-39	2	3
Total	59	100
Employment		
Full time	10	17
Part-time (20-30)	25	42
Part-time (10-20)	13	22
Part-time (<10)	2	3
Unemployed	9	15
Total	59	100
Reason		
Elective	7	12
Requirement	42	71
Other	10	17
Total	59	100

Table 6 also presents a major reason for taking Com S 103. Forty-two participants (71%) took this course as a requirement for their program studies, most likely probably because many departments at Iowa State University require this course to increase students' computer skills. Seven participants (12%) took it as an elective course. Ten participants (17%) took this course for various reasons, such as personal interests and desire for enhancement of computer skills.

Tests for Learning Outcomes and Learning Styles

The final grades of the participants were adopted by the researcher as a criterion with which to assess students' learning outcomes. The instructor in Com S 103 created a grading scale of A (93-100), A- (90-92), B+ (87-89), B (83-86), B-(80-82), C+ (77-79), C (73-76), C-

(70-72), D+ (67-69), D (63-66), D- (60-62), and F (0-59). In this study, the researcher grouped the scale into A (A, and A-), B (B+, B, and B-), C (C+, C, and C-), D (D+, D, and D-), and F.

Table 7 presents frequencies and percentages of final grades of the participants. Forty-one participants (69.5%) got an A, fourteen participants (23.7%) got a B, two participants (3.4%) got a C, one participant (1.7 %) got a D, and one participant (1.7%) failed this course with an F.

Table 7 Frequency and Percentage of Participants' Final Grades

Final Grade	Frequency	Percent
A	41	69.5
B	14	23.7
C	2	3.4
D	1	1.7
F	1	1.7
Total	59	100

The majority of participants got an A or B and the grade distribution was much skewed. Due to the ceiling effect, the majority of participants (93.2%) were in the top range of B or above. However, the average score for the previous traditional lecture/lab class was a C, according to the instructor. She mentioned three reasons of this skewed distribution and ceiling effect. First of all, open book quizzes were adopted in this blended course to focus on understanding rather than on memorizing details of computer literacy topics. Second, lectures were available online via WebCT and this offered flexibility to the students. They could, for example, go over lecture notes for review and make-up. Third, prior to taking this course, most of participants have already been familiar with one or more of the software applications which were covered in this entry-level course.

The data from Table 8 further explains why most participants obtained an A or a B grade from this course. It illustrates participants' prior experiences with the software application, and shows frequencies and percentages of software applications used by participants. Participants were allowed to choose multiple answers if applicable in the online survey. As seen in Table 8, participants knew word processing (98.3%), WebCT (76.3%), spreadsheet (71.2%), presentation (69.5%), web browsers (62.7%), database (30.5%), and web authoring (18.6%). The most frequently used software application was word processing (98.3%), and the least used software application was web authoring (18.6%).

Table 8. Percentage of Software Applications

Software Applications	Frequency	Percent
Word processing	58	98.3
Spreadsheet	42	71.2
Database	18	30.5
Presentation	41	69.5
Web browsers	37	62.7
Web authoring	11	18.6
Web CT	45	76.3

Table 9 shows mean scores, standard deviations and the distribution of final grades among four learning styles: Accommodator, Assimilator, Converger, and Diverger.

Table 9. Distribution of Final Grades across Learning Styles

Learning Style	Mean	Std. Deviation	Final Grade					Total
			A	B	C	D	F	
Accommodator	4.21	1.25	8	4	0	1	1	14
Assimilator	4.79	0.54	16	2	1	0	0	19
Converger	4.54	0.66	8	4	1	0	0	13
Diverger	4.69	0.48	9	4	0	0	0	13
Class	4.56	0.79	41	14	2	1	1	59

Note: Scale 5=Grade A, 4 = Grade B, 3 = Grade C, 2 = Grade D, 1 = Grade F
Grade A: A, A- (90-100), Grade B: B+, B, B- (80-89), Grade C: C+, C, C- (70-79), Grade D: D+, D, D- (62-69), Grade F (0-59)

The mean score of Assimilator (M=4.79, SD = 0.54) and the mean score of Diverger (M= 4.69, SD= 0.48) are higher than the total class mean score (M=4.56, SD= 0.79). Sixteen Assimilators got an A, while two Assimilators got a B. Nine Divergers got an A, while four Divergers got a B. Accommodators (M = 4.21, SD = 1.25) and Convergers (M = 4.54, SD = 0.66) have the same number of participants (N=13) receiving grades A and B, the only exception being an F for one Accommodator. The mean scores of Accommodator and Converger are lower than the total class mean score (M= 4.56). The distribution of final grades is not very typical for an undergraduate course. The ceiling effect of final grades makes it difficult to generalize which particular learning style helps students perform better in this blended course.

Analysis of variance (ANOVA) was conducted to test the relationship between learning styles and learning outcomes. As Table 10 illustrates, the analysis indicates that no significant relationship ($p< 0.05$) were found between learning styles and learning outcomes as measured by final grades of participants, $F = 1.58$, $p >0.05$.

Table 10. ANOVA Analysis of Final Grades and Learning Styles

Final Grades	Sum of Squares	Degree of Freedom	Mean Square	F ratio	P value
Between Groups	2.89	3	0.96	1.58	.20
Within Groups	33.52	55	0.61		
Total	36.41	58			

P<0.05

Tests for Satisfaction and Learning Styles

Student satisfaction is considered as a factor in judging the effectiveness of a traditional course, an online course and a blended course. The researcher grouped online survey questions associated with course satisfaction into general feelings (Q3, 11, 14, 15), communication and interaction (Q22, 24, 25), course organization and structure (Q18, 23, 28,

29), assessment (Q21, 26, 31), and weekly lab (Q30, 40) to investigate relationship with learning styles in this blended course(Table 11).

Table 11. Survey Questions Related to Course Satisfaction

General feelings
Q3: This was my first experience with an online course.
Q 11: Coming into this class, my attitude about an online format was positive.
Q 14: The course met my expectations.
Q 15: The course progressed at a fair pace.
Communication and interaction
Q 22: WebCT online chat room was helpful.
Q 24: The online discussions helped in my understanding and thinking for some of the course material.
Q 25: WebCT email was helpful for communication.
Course organization and structure
Q 18: I found the WebCT site easy to understand and navigate.
Q 23: The course schedule/calendar was useful.
Q 28: I found the computer literacy textbook to be very useful and informative.
Q 29: I found the lab book to be very useful and easy to learn from.
Assessment
Q 21: I found the weekly chapter assignments helpful with learning terminology and chapter content.
Q 26: I understood the grading policy.
Q 31: I found the web page assignments useful.
Weekly lab
Q 30: My TA's were friendly, knowledgeable, and helpful.
Q 40: The lab is an important part of this class and is helpful to my success in the course.

Table 12 shows that one significant relationship was found between course expectations and learning styles ($F = 3.13$, $p<0.05$). There was no significant relationship between experience and learning styles ($F= 2.28$, $p >0.05$), attitude and learning styles ($F = 0.41$, $p >0.05$), and course pace and learning styles ($F= 1.32$, $p >0.05$).

Table 12. ANOVA Analysis of General Feelings and Learning Styles

Source		Sum of Squares	Degree of Freedom	Mean Square	F ratio	P value
Experience	Between Groups	1.63	3	0.54	2.28	0.09
	Within Groups	13.15	55	0.24		
	Total	14.75	58			
Attitude	Between Groups	1.18	3	0.39	0.41	0.75
	Within Groups	53.13	55	0.97		
	Total	54.31	58			
Expectations	Between Groups	5.38	3	1.79	3.13	0.03*
	Within Groups	31.54	55	0.57		
	Total	36.92	58			
Course Pace	Between Groups	2.26	3	0.75	1.32	0.28
	Within Groups	31.37	55	0.57		
	Total	33.63	58			

* $P < 0.05$

The mean score and standard deviation of learning styles related to expectation were calculated to show its relations in Table 13. The course expectation was rated by a five-point agreement scale which 1 standards for strongly agree, 2 agree, 3 neutral, 4 disagree, and 5 strongly disagree. Table 13 shows that the mean scores of Assimilators (M = 1.58, SD = 0.77) Divergers (M= 1.69, SD = 0.48) were between "Strongly agree" and "Agree" in their opinion to Question 14: The course met my expectations, whereas the mean scores of Convergers (M= 1.92, SD = 0.64) and Accommodators (M= 2.36, SD = 1.01) were between "Agree" and "Neutral" in their opinion to Question 14: The course met my expectations.

Table 13. Mean Scores and Standard Deviation of Learning Styles across Expectations

	Learning Styles	N	Mean	Std. Deviation
Expectations	Accommodator	14	2.36	1.01
	Assimilator	19	1.58	0.77
	Converger	13	1.92	0.64
	Diverger	13	1.69	0.48
	Total	59	1.86	0.80

Question 14 in the survey: The course met my expectations.
Note: Scale 1= Strongly Agree, 2= Agree, 3 = Neutral, 4= Disagree, and 5 = Strongly Disagree

No significant relationship was found between learning styles and satisfaction associated with communication and interaction (Table 14) with respect to chat room ($F= 0.11$, $p >0.05$), discussion board ($F= 0.09$, $p >0.05$) and email ($F =1.70$, $p >0.05$). Learning style was not considered to be significantly related to communication and interaction in a blended learning environment.

Table 14. ANOVA Analysis of Satisfaction with Interaction and Learning Styles

Source		Sum of Squares	Degree of Freedom	Mean Square	F ratio	P value
Chat room	Between Groups	0.22	3	0.07	0.11	0.96
	Within Groups	38.32	55	0.70		
	Total	38.54	58			
Discussion	Between Groups	0.22	3	0.07	0.09	0.96
	Within Groups	43.95	55	0.80		
	Total	44.17	58			
Email	Between Groups	3.31	3	1.10	1.70	0.18
	Within Groups	35.58	55	0.65		
	Total	38.88	58			

$P<0.05$

Course organization was considered as another factor that might affect course satisfaction. In particular, students' opinions of Web CT navigation, course schedule, the text book for the online lecture and book for the lab session were used as variables for relation tests between course satisfaction and learning styles.

ANOVA analysis in Table 15 shows one significant relationship between schedule and learning styles ($F = 0.11$, $p < 0.05$). There was no significant relationship between Web CT navigation ($F = 1.12$, $p >0.05$), textbook ($F = 0.23$, $p >0.05$), and lab book ($F = 0.07$, $p >0.05$). Learning styles was not related to course satisfaction in terms of Web CT navigation, textbook and lab book.

Table 15. ANOVA Analysis of Satisfaction with Organization and Learning Styles

Source		Sum of Squares	Degree of Freedom	Mean Square	F ratio	P value
Web CT navigation	Between Groups	1.74	3	0.58	1.12	0.35
	Within Groups	28.66	55	0.52		
	Total	30.41	58			
Schedule	Between Groups	6.78	3	2.26	2.82	0.047*
	Within Groups	44.07	55	0.80		
	Total	50.85	59			
Text book	Between Groups	0.70	3	1.79	0.23	0.70
	Within Groups	27.23	55	0.57		
	Total	27.93	58			
Lab book	Between Groups	0.16	3	0.05	0.07	0.98
	Within Groups	41.47	55	0.75		
	Total	41.63	58			

* P<0.05

Table 16 shows mean scores and standard deviations of learning styles across course schedule. The mean score of schedule related to learning styles is 2.05. The mean scores of Assimilators (M = 1.68, SD = 0.95) and Divergers (M= 1.85, SD = 0.69) were between "Strongly agree" and "Agree", whereas the mean scores of Accommodators (M= 2.5, SD = 1.09) and Convergers (M= 2.37, SD = 0.75) were between "Agree" and "Neutral" in their opinion to Question 23: The course schedule was useful.

Table 16. Mean Scores and Standard Deviations of Learning Styles across Schedule

	Learning Styles	N	Mean	Std. Deviation
Schedule	Accommodator	14	2.50	1.09
	Assimilator	19	1.68	0.95
	Converger	13	2.31	0.75
	Diverger	13	1.85	0.69
	Total	59	2.05	0.94

Question 23 in the survey: The course schedule was useful.
Note: Scale 1= Strongly Agree, 2 = Agree, 3 = Neutral, 4 = Disagree, and 5 = Strongly Disagree

The ANOVA test in Table 17 shows that no significant relationship was found between course satisfaction and learning styles in terms of chapter assignment (F = 0.44, p>0.05), grading (F = 1.25, p>0.05), and webpage assignment (F = 0.86, p>0.05).

Table 17. ANOVA Analysis of Satisfaction with Assessment and Learning Styles

Source		Sum of Squares	Degree of Freedom	Mean Square	F ratio	P value
Chapter assignment	Between Groups	0.92	3	0.31	0.44	0.73
	Within Groups	38.87	55	0.71		
	Total	39.80	58			
Grading	Between Groups	1.28	3	0.43	1.25	0.30
	Within Groups	18.76	55	0.34		
	Total	20.03	59			
Webpage assignment	Between Groups	2.39	3	0.80	0.86	0.47
	Within Groups	51.24	55	0.93		
	Total	53.63	58			

$P<0.05$

Another ANOVA analysis was conducted to explore the relationship between learning styles and course satisfaction determined by the lab and teaching assistants (Table 18). No significant relationship was found between the lab and learning styles ($F = 0.34$, $p > 0.05$), and between teaching assistants and learning styles ($F = 0.58$, $p > 0.05$).

Table 18. ANOVA Analysis of Satisfaction with Lab and Learning Styles

Source		Sum of Squares	Degree of Freedom	Mean Square	F ratio	P value
Lab	Between Groups	0.78	3	0.26	0.34	0.80
	Within Groups	42.41	55	0.77		
	Total	43.19	58			
TA	Between Groups	0.67	3	023	0.58	0.63
	Within Groups	21.36	55	0.39		
	Total	22.03	58			

$P<0.05$

In addition to the survey questions associated with course satisfaction listed in Table 8, Question 32 on preferable delivery medium is also related to course satisfaction. It is not a five-point Likert type question, instead multiple answers were allowed to choose, if applicable. The purpose was to examine how participants viewed different delivery media to assist their learning in this blended course. Table 19 displays the results.

Table 19. Frequency and Percentage of Delivery Medium

Delivery Medium	Frequency	Percent
Visual	39	66.1
Audio	14	23.8
Video	18	30.5
Text	20	33.9
Multimedia (a combination of above)	35	59.3

Note: Scale A = Visual, B =Audio, C = Video, D = Text and E = Multimedia

Table 19 indicates participants' preferences with respect to visual delivery medium (66.1%), audio medium (23.8%), video medium (30.5%), text delivery medium (33.9%), and multimedia medium with a combination of either visual or audio and video (59.3%). The result reveals that visual medium (66.1%) and multimedia materials (59.3%) involved in the learning process were preferred by participants. This result might provide an instructor useful information to incorporate these delivery media into the course design for effective learning.

Students' Perspectives on Learning Styles, Learning Outcomes and Satisfaction

The purpose of the interviews was to obtain perspectives from the viewpoints of students to investigate whether learning styles bear any relationship with students' learning process, especially learning outcomes and course satisfaction in the blended learning environment.

Four participants selected to represent four learning styles were interviewed as listed in Table 20. For confidentiality, interviewees' real names were not revealed.

Table 20. List of Interviewees

Name	Learning Style	Major	Academic Classification
Jane	Accommodator	Accounting	Sophomore
Mary	Assimilator	Biology	Senior
John	Converger	Management Information Systems	Sophomore
Amy	Diverger	Geology	Junior

Interviewees' profile

Jane was a sophomore in the Department of Accounting. She took Com S 103 as a requirement, and she already knew word processing and spreadsheet from high school. She wanted to learn how to use database and webpage editing from this course.

Mary came from the Department of Biology. She was required to take the course for her major. She knew word processing and spreadsheet but was not confident in using some functions of these applications. She hoped to learn useful tricks and shortcuts and to improve her computer skills.

John was a second-year student in the Department of Management Information Systems. Though he was already familiar with computer applications covered in this course, he was required to take it as a degree requirement of the College of Business.

Amy was a third-year student majoring in geology. She wanted to take the course because she did not know much about computers. She used computers for basic things without going into depth. She hoped to gain more from this course.

Emergent themes

The following themes emerged from the qualitative analysis of the four interviews: a) flexibility and convenience in blended learning; b) perspectives on learning styles and learning outcomes; and c) perspectives on course satisfaction.

Flexibility and convenience in blended learning

Blended leaning in this particular study was accepted by four interviewees. During the interviews, they described benefits of lectures in the WebCT environment and the necessity of face-to-face communication and interaction in the lab session.

The following quotes reveal what interviewees felt about online learning and blended learning:

> *I think it (online learning) is a good idea, it's more self-motivated. I would like to take online classes because they free my time to work when I have to be in the class. It's more flexible, you can do stuff when you have time, if you have a very busy week ahead, you can try to get things done before, you don't have to worry about that class all the week (John, Converger).*

> *The online learning environment helps my learning needs in that it is flexible with time for answering or responding to questions or statements. I don't feel I have to fight or wait for my turn to "speak" (Jane,* Accommodator*).*

> *I benefit a lot from the blended course, and I am having a great time (Mary, Assimilator).*

> *I appreciate the online learning situation's flexibility and space. I have time to read, reread, write, edit, and refine contributions in order to be as clear as I can be. Just the process of doing this provides a certain amount of satisfaction (Amy, Diverger).*

The four interviewees talked about flexibility and convenience which were regarded as the major benefits of distance learning.

Jane, an Accommodator, depicted her understanding of flexibility in distance learning and blended learning:

> *It (blended course) is good for me, because you can study on your own, and you still have some time with TA for questions if you don't know anything. I don't have to go to lecture and listen to something I can read on my own, it's very flexible, and you can manage your own time and take responsibility of your learning and check Web CT.*

Mary, an Assimilator, mentioned taking responsibility in blended learning, another important issue in both online and blended learning setting:

> *I love this kind of learning (blended learning), I have to be responsible for myself, and in the classroom setting, when you turn in homework or assignment every week, there is always somebody with excuses, oh, I forgot, or whatever. For the electronic version, you have to be responsible because they always told me to turn in on time.*

John, a Converger, selected the blended course as a substitute for the traditional lecture class, because "it (the lecture) does not do a lot for me, and I need to read stuff and write down something, online learning gives me chances to think and read at my own pace."

Amy, a Diverger, listed reasons why she preferred blended learning:

> *It (blended learning) gives you independence and how you learn and you can learn faster than others. Sometimes I am slower and sometimes I am faster, it's nice to be able to go through at my pace, if I need help, I can get help in the lab, and I don't feel intimated asking questions at all.*

Although there were benefits of flexible learning in a virtual or blended form, four interviewees did not think that all classes are suitable for this kind of flexible and self-regulated learning, because "it depends on how difficult the class is. If you learn a hard concept, it's better in the class so you can hear examples and explanations. For this beginning level class, it should have no problem at all (Amy)." Mary thought that "being online totally is not proper for all students. It depends on different people."

In summary, there was no particular learning style preferred by the four interviewees in this blended course. The Assimilator (Mary), Accommodator (Jane), Converger (John) and Diverger (Amy) all preferred flexibility and convenience brought by distance learning and blended learning.

Perspectives on learning styles and learning outcomes

During the interviews, four interviewees described how they incorporated their learning styles in Com S 103 as a blended course.

Amy, a Diverger, resorted to imagination, examples and logical thinking to form her new knowledge and concept. She preferred concrete examples to assist her understanding. This corresponds to the description of Divergers by Kolb (1984) who describes them as good

at using concrete examples, experiences and feelings in the learning process. She commented on her learning style.

> *I learn better from examples, and build up new concepts from examples, maybe a little bit from experience and logical thinking. If I have a concrete example, I will be more likely to remember it, because it's just concrete, it's not a theory. Concrete examples give me better pictures of new knowledge. To me, learning from a theory is too abstract. So examples build up a frame for me to get ideas and gather information.*

Jane, an Accommodator, preferred doing things while learning. Jane described that "I am the person if I do something on my own, then definitely I remember one. I think I am a better learner while doing something. I am a kind of hands-on person." According to Kolb (1984), this is typical for an Accommodator whose learning strength lies in doing things, in carrying out plans and experiments, and becoming involved in new experiences. People with this learning style have the ability to learn from primarily hands-on experience.

Mary, an Assimilator, described her learning style as "I am good at putting pieces and linking them together to form logical thinking. I don't have any problems with abstract ideas and concepts." According to Kolb (1984), this is typical for an Assimilator with the learning strength in logical and analytical abilities.

John, a Converger, described himself as being capable of finding solutions to questions and problems. He said that "I am a MIS major. We always have some assignments involving critical thinking to find solutions and make decisions." According to Kolb (1984), people with this learning style are best at finding practical uses for ideas and theories. They have the ability to solve problems and make decisions based on finding solutions to questions or problems. So, John is a typical Converger.

The characteristics of the four interviewees with respect to learning styles correspond to Kolb's learning style description.

With regard to learning outcomes, all four interviewees had high expectations to perform well in Com S 103. Final grades were used as an indicator of their academic achievement to measure learning outcomes in this study. Jane (Accommodator), Mary (Assimilator), and Amy (Diverger) got an A, and John (Converger) got a B from this blended course.

During the interview, each interviewee described his/her expectation toward the course.

> *I am going to get a good grade. As long as you do the assignment well, you will be fine (Mary, Assimilator).*
>
> *I am a pretty good student, and I did well at high school. I have a goal like A or A-. I am not worrying about it. I think I will be OK (Jane, Accommodator).*
>
> *I want to get a good grade and this is not a difficult class (Amy, Diverger).*
>
> *I think I will be fine. I am pretty comfortable with computers. It seems pretty basic, but there is something still a little bit hard (John, Converger).*

Evidence collected from the four interviews indicates that interviewees all had high expectations of this course. The only exception is that John, a Converger who was the only male in the four interviews, did not seem to have much confidence in using some of software applications. Regardless of prior computer knowledge and experience, he still thought that there were some challenging problems when they did lab assignments.

Perspectives on course satisfaction

Student satisfaction with the course is considered important for the success in both distance learning and blended learning. It is important to gather information and to gain

insights into student feelings, and to gauge the online course catering for their needs thereafter. Interview data from participants served this purpose. Satisfaction is reported from course organization in WebCT, multimedia delivery medium, and weekly lab in four interviews.

The interviewees were confident in using WebCT for lectures. They thought WebCT was easy to navigate and locate course information. The instructor made a great effort to organize course content, assignment and other helpful information in the WebCT course site.

> *I use Web CT quite often, I check it once a day, at least once a day for announcement to see what I have anything due, and get something done. Reading in WebCT is pretty self-explanatory and easy, so when you read it, it all makes senses. Everything we have is very helpful. They don't really have anything like wasting our time for us to do. Practice in the lab helps us improve our computer skills, and it will help me in the future too (Mary, Assimilator).*

> *WebCT is very handy. I used WebCT before for other classes, but they don't have much stuff on WebCT like Com S 103. You can email, and turn in assignment. I can keep track of my grade and other stuff once it's updated (Jane, Accommodator).*

Amy added her opinion. The idea of involving learning styles into course design is valuable and she thought that the consideration of learning style provided another angle for the instructor to teach.

> *You can't design a class, you know, to cater very single person, because everyone is going to be different, so unless it's a one-to-one class, if the teacher is trying to do that, it's a nice goal, but I don' t know if that will happen (Amy, Diverger).*

Mary agreed that the consideration of learning styles in course design was useful and helpful to students. She said that "I think it will help, because everybody learns differently, and everybody at different level."

The above comments on WebCT are somewhat related with the first theme, i.e. flexibility and convenience in blended learning, since WebCT provides a good learning platform for these two benefits.

A multimedia delivery medium may assist student learning and improve student performance. Three interviewees (Jane, Mary and Amy) agreed that multimedia materials in the class were beneficial to their learning as results shown in Table 19.

> *It (multimedia) is very helpful, because I am hearing words and I could see things moving around and putting together, so audio or video or the combination of both will be really beneficial. It will stimulate your learning (Mary, Assimilator).*

> *One-third of the time in the class you listen, one-third of the time you read. More interaction is helpful too, say give the class a couple of quiz questions or practice exam questions, and have students work with neighbors and discuss an assigned topic. This is where I had most success in learning instead of just listening (Jane, Accommodator).*

However, John, a Converger did not think that multimedia materials were helpful and useful in his learning at all.

> *Visual materials don't do anything to me, because I get bored watching while listening, unless it's the subject I am really interested otherwise my mind just wonders. I won't take advantage of it (John).*

Blended learning combines both an online lecture and a weekly lab. Four interviewees thought that weekly lab offered a very good opportunity to ask questions, solve problems, and interact with other students. It played an important role in getting practical experiences in Com S 103.

Here is a quote from Amy, a Diverger:

> *During the labs, I can ask questions all the time. You can show what you are doing and point where you stuck, TAs can solve the problem instantly. If everything goes online, you have to email someone for help, and they will have to look at all your stuff, and figure what goes wrong. There is always time delay. You have to wait for the response, and you have to see if the instructor gets time to open the mailbox and*

check the emails. That's a big thing, the response always takes forever. I preferred blended learning; it's a good idea, because for computer skills, you need to practice. Otherwise, you just forgot how to do Excel, how to add formulas, and so on.

Jane, an Accommodator, had the same feeling:

The lab really reinforces my learning, and readings of computer literacy online. You get hands-on experiences. TAs are really helpful, they are great at explaining, they won't do the work for me, but they point out and help me solve it. I think the lab is a good thing; it will be really hard to the entire class online.

Mary, Assimilator, described how she felt the lab.

I think lab helps a lot. I've never used Access before, so it helps a lot to be familiar with that program, so I like being in the lab. I will be feeling more comfortable using computers. I don't think I will be hesitatant to learn any new programs... I lost interest in a classroom setting, but meeting in the lab is nice, it helps keep me in check and also gives me freedom. If I took an all online class, I'd probably do poorly and stress myself out.

The above quotes reflected very positive comments on the weekly lab with the supplementary lecture in the WebCT course site. However, John, Converger, made a negative comment on the lab. He said that he already knew a lot about computer application before. "The lab forces you to do the program. I don't think I have to do it by myself." He thought that lab practice was still counted as a traditional class without much flexibility.

In general, interviewees' attitudes for this blended course are positive except John, a Converger. Blended learning complements online lectures, weekly lab and other resources. Perspectives on it become an important dimension of this study. It is the blended learning that makes this study different.

Summary

This chapter presented the research results on learning styles, learning outcomes and course satisfaction in the context of blended learning. The findings of this study suggest little relationship among learning styles, learning outcomes and course satisfaction. Course

satisfaction was assessed by general feelings about the course, course content and organization, communication and interaction, assessment, and the weekly lab to seek its relationship with learning styles. The findings of this study indicate that there exists little relationship with different learning styles and course satisfaction in terms of general feelings, course organization and structure, assessment and weekly lab. However, significant relationships have been found in course expectation ($p< 0.05$) and course schedule ($p< 0.05$) related to learning style, with the relation representing for Assimilators and Divergers. Delivery medium was assessed as another aspect of course satisfaction with which visual (66.1 %) and multimedia materials (59.3 %) were most often preferred by participants. Interview confirmed this while also illustrating that one out of the four participants interviewed did not use the multimedia, and that one of the four participants did not like the lab. Three themes emerged from the interviews of the four participants: flexibility and convenience in blended learning, perspectives on learning style and learning outcomes, and perspectives on course satisfaction. Interview data support the analysis from quantitative data.

CHAPTER 5. SUMMARY, DISCUSSION AND RECOMMENDATION

In the first four chapters of this thesis, the background, related literature, research methodology, and research findings were presented. The purpose of this chapter is to briefly summarize the research study, to discuss the research findings in the context of the literature, to list some limitations of the study, and to provide recommendations for further research about learning styles in a blended learning environment. A personal reflection concludes the thesis.

Learning Styles

In this study, there were a little more Assimilators (32.2%) than Accommodators (23.7%), Convergers (22%), and Divergers (22%) in Com S 103. According to Kolb (1985, 1999), Assimilators prefer to combine Abstract Conceptualization (AC) with Reflective Observation (RO)and are proficient at taking in a wide range of information and reducing it to a more logical form. Assimilators tend to be more oriented toward theoretical models and deductive reasoning and are more interested in abstract concepts and ideas. This type of learner should have fewer problems with an online lecture and a face-to-face lab than his or her peers who prefer the Accommodator, Converger and Diverger learning style.

In contrast, Accommodators prefer to use Concrete Experience (CE) and Active Experimentation (AE). They like to do things, to carry out plans and tasks. They are hands-on learners who rely on intuition and other people's analysis in solving problems or making decisions. Convergers prefer to use Abstract Conceptualization (AC) and Active Experimentation (AE). They are good problem solvers and decision-makers. Divergers prefer to combine Concrete Experience (CE) and Reflective Observation (RO). They are able to

view concrete situations from many perspectives and generate alternative ideas (brainstorming) and solutions to problems. They like to watch rather than to take action.

Each learning style has its strengths and weaknesses, and no single learning style is best. The most versatile learners, however, should be able to competently use each learning mode when it is called for (Kolb, 1984).

As it was discussed in the first and second chapter, the concept of learning styles has implications for educators. It is beneficial to recognize the relationship of learning styles and incorporate it into course design and development to enhance the students' learning experiences. Developing a well-balanced learning cycle rather than focusing on one particular learning mode is needed. Kolb, Boyatzis,& Mainemelis(1999) suggest integrated learning, which is conceptualized as an idealized learning cycle or spiral where the learner "touches all the bases" (p.22) – experiences, reflecting, thinking, and acting – in a recursive process that is responsive to the learning situation and what is being learned. By recognizing the learning mode that students are in, acknowledging and allowing the use of their learning strengths, and then working through the other modes, teachers provide students the best chance of success.

Teachers should avoid inadvertently teaching to only one learning style as this might place some students at a disadvantage. Effective teaching can be accomplished by using lesson and learning plans that use both modes of grasping (feeling and thinking) and both modes of processing (reflecting and doing). Students can meet CE (Concrete Experience) needs by discussing how they feel about new knowledge, skills, and attitudes acquired in a course, just as others can meet AC (Active Conceptualization) needs by defining the conceptual framework within which new material must fit. Students may need more RO

(Reflective Observation) processing time prior to applying the skills, and those students who want to practice new skills early AE (Active Experimentation), will benefit from multiple opportunities to practice.

Summary of the Research Study

The purpose of the study was to investigate how learning styles are related to learning outcomes and course satisfaction in a blended learning environment, specifically Com S 103 offered during the summer session of 2004 by the department of Computer Science at Iowa State University. The research questions were:

1. What, if any, relationship exists between learning styles as measured by Kolb's Learning Style Inventory and learning outcomes as measured by participants' Com S 103 final grades?
2. What, if any, relationship exists between learning styles and course satisfaction?
3. What, if any, relationship exists between learning styles and students' performance?

Both quantitative and qualitative evidence were used to capture these relationships in a picture of Com S 103, which is as a blended course. Quantitative data were collected by applying two instruments: Kolb's Learning Style Inventory (with permission from Hay Group) and an online survey developed by the Com S 103 instructor and extended by the researcher. Students were divided into categories of Accommodator, Assimilator, Converger and Diverger, the four learning styles defined by Kolb (1985, 1993) by a determination based on the scores of AC-CE (Abstract Conceptualization - Concrete Experience) and AE-RO (Active Experimentation - Reflective Observation) from Kolb's Experiential Learning Theory. Final grades of participants as an indicator of learning outcomes were used as one of the dependent variables to explore its relation with these learning styles. The online survey

posted in the course WebCT site sought student comments on the course. Questions related to the focus of the research study were: components of course satisfaction based on general feelings, communication and interaction, course organization and structure, assessment, weekly lab and multimedia delivery medium.

Quantitative data were analyzed through SPSS version 12.0 and Microsoft Excel 2003. The analysis included demographic background information, mean scores and standard deviations of learning styles and ANOVA analysis for relations of learning styles, and learning outcomes and course satisfaction. The quantitative data analysis did not indicate a significant relationship between learning styles and learning outcomes as indicated by participants' final grades of Com S 103. There was no significant relationship between learning styles and course satisfaction in terms of general feelings, communication and interaction, course organization and structure, assessment, or weekly lab.

Two significant relationships were found between learning styles and course expectation ($F=3.13$, $p<0.05$), and a second between learning styles and course schedule ($F=2.82$, $p<0.05$). The mean scores of Assimilators and Divergers were between "strongly agree" and "Agree", whereas the mean scores of Accommodators and Convergers were between "Agree" and "Neutral" in their opinion to Question 23 in the survey: The course schedule was useful. The mean scores of Assimilators and Divergers were between "strongly agree" and "Agree", whereas the mean scores of Accommodators and Convergers were between "Agree" and "Neutral" in their opinion to Question 14 in the survey: The course met my expectations.

Qualitative data were collected by interviews of four students who were selected to represent the four learning styles: Accommodator, Assimilator, Converger and Diverger. The

four interview transcripts were analyzed, and checked with interviewees to ensure reliable interpretation. Three themes emerged: flexibility and convenience in blended learning; perspectives on learning styles and learning outcomes; and perspectives on course satisfaction. All interviewees valued the flexibility and convenience brought by blended learning with the utilization of instructional technology without the loss of face-to-face contact and synchronous communication. All interviewees had very high expectations of getting good grade from the course, they regarded schedule as a useful resource to take responsibility for their learning which occurred in an online and face-to-face context. Three out of four interviewees regarded multimedia materials in the course as a useful supplement to help them with new concepts and theories. Three interviewees preferred the weekly lab for computer applications practice. The Converger, the only male interviewed, did not like the lab. All four interviewees thought that teaching assistants were very helpful.

The quantitative and qualitative analyses showed very little relationship among learning styles, learning outcomes and course satisfaction in a blended learning environment. Research findings and results were reported in detail in Chapter Four. The following section discusses the research results and findings.

Discussion of the Results

Learning styles and learning outcomes

Learning styles have been researched to investigate the relationship with learning outcomes in a traditional face-to-face learning environment. This has led to an increased understanding and acknowledgement that not everyone learns in the same way. Some research studies (Dexter, 1995: Larsen, 1992; Neuhauser, 2002; Shin & Gamon, 1999; Wang et al., 2001) were not able to identify any relationship between learning style and academic

performance. For example, Dexter's research (1995) concluded that there was no significant relation in the performance outcomes between the on-campus and off-campus students. No correlation was found in learning styles among students.

In this study, the quantitative data analysis showed very little relationship among learning styles and learning outcomes. The data analysis does not indicate that student learning outcomes as measured by finals grades of participants in Com S 103 were directly related to learning styles. It should be noted that there was a ceiling effect that the majority of participants (93.2%) got a B or above, which may have obscured findings. These findings are in keeping with the research results that there is no significant relationship between learning styles and learning outcomes in distance learning environment (Larsen, 1992; Neuhauser, 2002; Shih & Gamon, 1999; Wang et al., 2001). Larsen (1992) found no significant differences between learning style groups and suggested that both effectiveness and satisfaction are independent of students' learning style preference. Neuhauser (2002) found no significant differences between learning styles, perceptions of course, task effectiveness, technical competence and course grades when compared two sections of the same course, one taught online and the other taught using a face-to-face format. Shih and Gamon (1999) found that student learning styles did not have an effect on their web-based learning achievement. Wang et al. (2001) found no changes in student learning styles and no significant difference in learning outcomes and learner satisfaction with regard to different learning styles.

Qualitative analysis from the interviews did not indicate a direct relation between learning styles and learning outcomes. There were differences between interviewees but there was no clear relationship of those differences with learning styles, for example, all four

interviewees had high course expectations to perform well and get good grades. This may have a ceiling effect, since the majority of participants got an A or B from the course, and this reduced the differentiation that could be determined with the relation to learning styles.

The findings do not support the research indicating that the Assimilator is a predictor of academic success (Diaz & Cartnal, 1999; Dille & Mezack, 1991; Gee, 1990; Terrell & Dringus, 2000; Terrell, 1995). Dille and Mezack (1991) found that students with a less concrete style are better suited to the telecourse learning. Diaz and Cartnal (1999) got a similar result and suggested that students with less need for Concrete Experience in learning may be expected to perform better and thus be better suited to the distance format. Gee (1990) found that Assimilator performed better. The pattern is consistent with the description of the AC scale, which stresses an intellectual or analytical approach to learning. Terrell and Dringus (2000) found that Assimilators were predictor of success in the graduate degree program. Terrell (1995) found that students taking computer-mediated coursework were primarily Assimilators. However, the findings of this study did not suggest that the Convergers are more comfortable and performs better in distance learning than in traditional instruction (Dille & Mezack, 1991; Gee, 1990; Terrell, 1995). Gunawardena & Boverie (1993) found that learning styles do affect course satisfaction, with Accommodators being the most satisfied and the Divergers being the least satisfied with class. No similar results have been found in this study.

Learning styles and course satisfaction

There was little relationship between learning styles and course satisfaction in terms of general feelings, course organization and structure, communication and interaction, assessment, and weekly lab. Two significant relationships were found between learning

styles and course expectations ($F=2.82$, $p<0.05$), between learning styles and course schedule ($F=3.13$, $p<0.05$).

Another difference, which was derived from the interview data, was that one interviewee, the Converger, did not like the lab session. However, it is hard to attribute this to his learning style, although Convergers are less likely to value hands-on activities according to Kolb (1984). Dille & Mezack (1991) and Terrell (1995) showed that Convergers perform well and are suited to the distance learning. This study may suggest that Convergers may not perform well, and they may not be satisfied with the learning experience in blended learning, but with only one Converger who was also the only male in the interview, this finding is very tentative.

These findings are in keeping with the research results that there is no significant relationship between learning styles and course satisfaction in distance learning environment (Larsen, 1992; Neuhauser, 2002; Shih & Gamon, 1999; Wang et al., 2001). Wang et al. (2001) found no changes in student learning styles and no significant difference in learner satisfaction with regard to different learning styles.

Course satisfaction provides one possible source of evaluation that should be compared to other methods of evaluating the effectiveness of any pedagogical device or procedure (Allen et al., 2002). Therefore, in both distance learning and blended learning, it is likely that multiple factors affect student learning, such as motivation, technology and instructional design can affect student learning (Billings & Cobb, 1992).

Flexibility and convenience in blended learning

Students are drawn to distance education courses for their convenience and flexibility (Holmberg, 1986; Kearsley, 2000). The interview data in the study support this. Participants

preferred the asynchronous nature of this blended course with the combination of an online lecture and a face-to-face practical lab. Isolation due to geographical distance and lack of interaction and communication is strengthened in the lab through face-to-face interaction with teaching assistants and peers. Such a mixed model brings participants flexibility and convenience to manage and allocate their study time effectively and efficiently. In the four interviews, participants provided very positive comments on the lab session and highly recommended the weekly lab as an essential element to work on assignments, seek help from peers and teaching assistants, and obtain hands-on experiences with software applications in addition to learning computer literacy from online lectures.

The qualitative evidence revealed that blended learning was welcomed by participants with various learning styles. This form of learning environment blends online learning with more traditional methods of learning and development. This study suggests that blended learning offers a good opportunity to maximize students' learning. There are some other variables which may influence the success of online or blended learning. These include technology (Hackman & Walker, 1990), human factors (eg. personality, attitude, skill) (Allen et al., 2002), and instructional design (McLoughlin, 1999).

Limitations of the Study and Recommendations

As with any study, there are situational and methodological limitations to be considered. The limitations of this study are as follows.

First, the data collected from Kolb's Learning Style Inventory and online survey were self-reported and, as such, were subject to reporting bias.

Second, because the research participants were chosen from summer session, they were somewhat differently motivated from full semester students and that might affect their

performance. It would be valuable to study learning styles of students in regular semesters in the future to generalize the research findings.

Third, the study was limited to one course in one university. Further research needs to be done to generalize the results to be applicable to similar programs in higher education.

Fourth, a larger sample is needed to get reliable results for the future exploration of relationship of learning styles with learning outcomes and course satisfaction in a blended course.

Last, the study did not explore the relationship of learning styles with discipline and gender. Future research needs to be conducted in a blended learning environment.

Reflection

This study provided me a good opportunity to conduct a research using both the qualitative and quantitative research methods from the courses I took during my graduate study in the program of Curriculum and Instructional Technology in the Department of Curriculum and Instruction. I realize that doing a research is not an easy job; it requires a lot of time and effort to read the relevant literature, analyze and synthesize your own literature review, design study instruments, collect data and documents, and use the appropriate methodology for the data analysis. Although the process is time-consuming, it is a rewarding experience for me as a scholar. As a scholar, I have learned that it is critical to have a positive attitude and a strong interest. I chose to explore the topic of learning styles in the context of blended learning to explore under the supervision of my major professor and I remain very interested in further investigating whether learning styles have any relationships with learning outcomes and course satisfaction. The motivation and interest support me to go

through the processes of reading literature, data collection and analysis, research findings interpretation and writing the thesis.

The study, of course, has some limitations. If I was given another chance to conduct this study, I would:

1. Encourage more students to participate in the study and arrange for a large sample for more convincing and persuasive research results.
2. Allocate more time to study SPSS to improve the statistical analysis. This study was limited to a basic analysis including frequency, percentage, mean, standard deviation and one-way ANOVA test.
3. Spend more effort in testing survey questions for reliability and validity. Multiple answers were allowed in a few survey questions, but this should be avoided in the future.

In all, I have learned a great deal from this research study. It will enable me to conduct further research in my future career in the area of instructional technology.

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APPENDIX A. HUMAN SUBJECTS EXEMPTION

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office of Research Compliance
Vice Provost for Research and
Advanced Studies
2810 Beardshear Hall
Ames, Iowa 50011-2036
515 294-4566
FAX 515 294-7288

DATE: June 1, 2004

TO: Yahong Xu

FROM: Ginny Austin, IRB Coordinator

RE: **IRB ID # 04-273**

STUDY REVIEW DATE: May 27, 2004

The Institutional Review Board has reviewed the project, "Learning styles, learning outcomes and course satisfaction: An investigation of a blended computer literacy course" and has determined that it is exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) 2. The applicable exemption category is provided below for your information. Please note that you must submit all research involving human participants for review by the IRB. Only the IRB may make the determination of exemption, even if you conduct a study in the future that is exactly like this study.

The IRB determination of exemption means that this project does not need to meet the requirements from the Department of Health and Human Services (DHHS) regulations for the protection of human subjects, unless by the IRB. We do, however, urge you to protect the rights of your participants in the same ways that you would if your project was required to follow the regulations. This includes providing relevant information about the research to the participants.

Because your project is exempt, you do not need to submit an application for continuing review. However, you must carry out the research as proposed in the IRB application, including obtaining and documenting (signed) informed consent if you have stated in your application that you will do so or required by the IRB.

APPENDIX B. INFORMED CONSENT FORM (LSI and Survey)

Title of Study: Learning styles, learning outcomes and course satisfaction: An investigation of a blended computer literacy course

Investigator: Yahong Xu, graduate student in the Department of Curriculum and Instruction, College of Education, Iowa State University

Purpose of study
You are being asked to participate in a study of relationships among learning styles, learning outcomes and course satisfaction in Com S 103. The research seeks to explore if learning styles correlates with learning outcomes and satisfaction in the blended learning environment.

Description of Procedures
You are being asked to participate in a Learning Style Inventory questionnaire developed by David Kolb and an online survey in Com S 103 WebCT site. The Learning Style Inventory will take you about 10 minutes. The survey will take you 15-20 minutes. You are allowed to skip questions which you are not sure about or uncomfortable to answer. You will be contacted to assess the accuracy of the researcher's notes and interpretation and to provide feedback on preliminary research results.

Risks
There are no foreseeable risks at this time from participating in this study.

Benefits
It is hoped that the information gained in this study will benefit college students to enhance learning and academic achievement in a blended learning environment. The data collected from this study will also provide useful information on course design and curriculum development.

Participant Rights
Your participation is completely voluntary. This is not associated with any course assessment. You may stop participating in this research at any time or choose not to answer any question without penalty. If you decide not to participate in the study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled.

Confidentiality
Although disclosure of your identity is a possible risk, every precaution will be taken to protect your privacy and the confidentiality of any records generated by this research. The data will be retained till the end of the study. Your name and any other identifying information will not appear in any reports or documents that are published as a result of this research study.

Questions or Problems
If you do not understand any portion of what you are being asked to do, or the contents of this form, the researcher is available to provide a complete explanation. Questions are welcome at any time. Please direct them to Yahong Xu (N005 Lagomarcino Hall, Department of Curriculum and Instruction, College of Education, Iowa State University; 294-6167, yahongx@iastate.edu). You may also contact her major professor (Dr. Niki Davis, N108 Lagomarcino Hall, Department of Curriculum and Instruction, College of Education, Iowa State University, 294-5596, nedavis@iastate.edu) for any questions about this study.

Subject Signature
Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document and that your questions have been satisfactorily answered. You will receive a copy of the written informed consent prior to your participation in the study.

I have read the statements contained herein, have had the opportunity to fully discuss my concerns and questions, and fully understand the nature and character of my involvement in this research project as a human subject, and the attendant risks and consequences.

Subject's Name (printed): _____

Subject's Signature Date

Researcher Date

APPENDIX B. INFORMED CONSENT FORM (Interview)

Title of Study: Learning styles, learning outcomes and course satisfaction: An investigation of a blended computer literacy course

Investigator: Yahong Xu, graduate student in the Department of Curriculum and Instruction, College of Education, Iowa State University

Purpose of study
You are being asked to participate in a study of relationships among learning styles, learning outcomes and course satisfaction in Com S 103. The research seeks to explore if learning styles correlates with learning outcomes and satisfaction in the blended learning environment.

Description of Procedures
You are being asked to participate in an interview about your perspectives of learning styles and how learning styles relates to learning outcomes and satisfaction with Com S 103. The interview will take approximately 30-40 minutes. It will take place at the location convenient for you. You will be asked to allow the researcher named below to participate with you in this study and to document your engagement in each interview and observation. You will be contacted to assess the accuracy of the researcher's notes and interpretation and to provide feedback on preliminary research results.

With your permission, the interview will be audio taped. The tape will be transcribed; your name or other identifying information will **not** be included on the transcript.

Risks
There are no foreseeable risks at this time from participating in this study.

Benefits
It is hoped that the information gained in this study will benefit college students to enhance learning and academic achievement in a blended learning environment. The data collected from this study will also provide useful information on course design and curriculum development.

Participant Rights
Your participation is completely voluntary. This is not linked with any course assessment. You may stop participating in this research at any time or choose not to answer any question without penalty.

Confidentiality
Only the principal researcher will have access to the audiotapes of the interviews and the transcripts. The data will be retained till the end of the study. Your name and any other identifying information will not appear in any reports or documents that are published as a result of this research study.

Questions or Problems
If you do not understand any portion of what you are being asked to do, or the contents of this form, the researcher is available to provide a complete explanation. Questions are welcome at any time. Please direct them to Yahong Xu (N005 Lagomarcino Hall, Department of Curriculum and Instruction, College of Education, Iowa State University; 294-6167, yahongx@iastate.edu). You may also contact her major professor (Dr. Niki Davis, N108 Lagomarcino Hall, Department of Curriculum and Instruction, College of Education, Iowa State University, 294-5596, nedavis@iastate.edu) for any questions about this study.

Subject Signature
Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document and that your questions have been satisfactorily answered. You will receive a copy of the written informed consent prior to your participation in the study.

I have read the statements contained herein, have had the opportunity to fully discuss my concerns and questions, and fully understand the nature and character of my involvement in this research project as a human subject, and the attendant risks and consequences.

I give my permission to audiotape two interviews and observe class activities. ___ Yes____ No

Subject's Name (printed): _____

Subject's Signature Date

Researcher Date

APPENDIX C. LSI RESEARCH APPROVAL

From: michelle_curran@haygroup.com
Tue, 11 May 2004 13:42:11 -0400
LSI Research Approval

Hi Yahong,
Thank you for your interest in the *Learning Style Inventory* (LSI). In cooperation with David A. Kolb you have been approved to do research using the LSI, in return for a copy of your findings.

Attached you will find two documents (.pdf files--Adobe Acrobat 4.05):

* LSItest.pdf - This is a copy of the LSI test. You may print or copy this document as needed for your research.

* LSIprofile.pdf - The profile sheet contains the answer key for the test as well as the profiling graphs for plotting scores. This document may also be reproduced as necessary for your research. The AC-CE score on the Learning Style Type Grid is obtained by subtracting the CE score from the AC score. Similarly, the AE-RO score = AE minus RO.

We look forward to hearing about your results.

If you have any further questions, please let me know.

Regards,

Michelle Curran
Hay Resources Direct

Attachment #1: ***Mcb200d.pdf*** (Learning Style Inventory)

Attachment #2: ***MCB 200C.PDF*** (Learning Style Type Grid)

APPENDIX D. LEARNING STYLE INVENTORY

LEARNING-STYLE INVENTORY

The Learning-Style Inventory describes the way you learn and how you deal with ideas and day-to-day situations in your life. Below are 12 sentences with a choice of endings. Rank the endings for each sentence according to how well ou think each one fits with how you would go about learning something. Try to recall some recent situations where you had to learn something new, perhaps in your job or at school. Then, using the spaces provided, rank a "4" for the sentence ending that describes how you learn *best*, down to a "1" for the sentence ending that seems least like the way you learn. Be sure to rank all the endings for each sentence unit. Please do not make ties.

Example of completed sentence set:

1. When I learn: 2 I am happy. 1 I am fast. 3 I am logical. 4 I am careful.

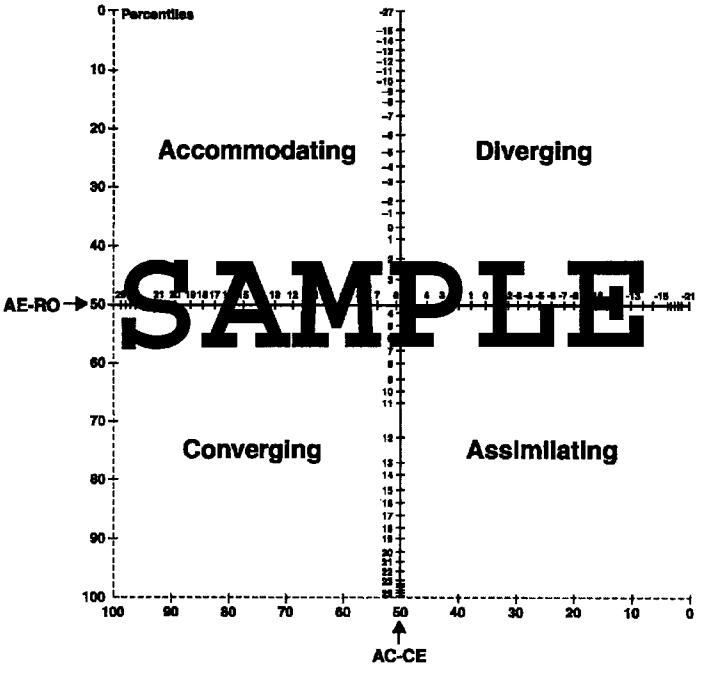
Remember: 4 = *most* like you 3 = *second most* like you 2 = *third most* like you 1 = *least* like you

	A		B		C		D	
1. When I learn:	___	I like to deal with my feelings.	___	I like to think about ideas.	___	I like to be doing things.	___	I like to watch and listen.
2. I learn best when:	___	I listen and watch carefully.	___	I rely on logical thinking.	___	I trust my hunches and feelings.	___	I work hard to get things done.
3. When I am learning:	___	I tend to reason things out.	___	I am responsible about things.	___	I am quiet and reserved.	___	I have strong feelings and reactions.
4. I learn by:	___	feeling.	___	doing.	___	watching.	___	thinking.
5. When I learn:	___	I am [illegible] new experiences.	___	[illegible] all [illegible]	___	I like [illegible] things [illegible] them [illegible] parts.	___	I like to try things out.
6. When I am learning:	___	I am an observing person.	___	I am an active person.	___	I am an intuitive person.	___	I am a logical person.
7. I learn best from:	___	observation.	___	personal relationships.	___	rational theories.	___	a chance to try out and practice.
8. When I learn:	___	I like to see results from my work.	___	I like ideas and theories.	___	I take my time before acting.	___	I feel personally involved in things.
9. I learn best when:	___	I rely on my observations.	___	I rely on my feelings.	___	I can try things out for myself.	___	I rely on my ideas.
10. When I am learning:	___	I am a reserved person.	___	I am an accepting person.	___	I am a responsible person.	___	I am a rational person.
11. When I learn:	___	I get involved.	___	I like to observe.	___	I evaluate things.	___	I like to be active.
12. I learn best when:	___	I analyze ideas.	___	I am receptive and open-minded.	___	I am careful.	___	I am practical.

MCB200C

APPENDIX D. LEARNING STYLE TYPE GRID

LEARNING-STYLE TYPE GRID



APPENDIX E. SURVEY

Question 1
I am an ISU student taking Com S 103. My participation in this survey is completely voluntary, and I can skip any questions I do not wish to answer. I understand that my responses are anonymous (it is not known who gives what response). I understand that the results of this survey will be used to improve Com S 103 in the future, and possibly as part of a research study or report to share knowledge about technology and education. If I have any questions, I may contact the instructor, _____. I have read the above statements and give my permission for my responses in this survey to be used accordingly.

a. Agree b. Disagree

Question 2
My Research ID number for this class is: _____

Question 3
This was my first experience with an online course.

a. Yes b. No

Question 4
My classification is

a. freshman
b. sophomore
c. junior
d. senior
e. other

Question 5
My age range is

a. < 18
b. 18-22
c. 23-29
d. 30-39
e. 40-49
f. >= 50

Question 6
My ethnicity is

a. African-American
b. Asian
c. Caucasian
d. Hispanic or Latino
e. Native American
f. Other

Question 7
My gender is

a. Male b. Female

Question 8
My major is in the following college:

a. Agriculture
b. Business
c. Design
d. Education
e. Engineering
f. Family and Consumer Sciences
g. Liberal Arts and Sciences
h. Veterinary Medicine
i. Other

Question 9
My employment status is

a. Full-time (40 hours/week)
b. Part-time (20-30 hours/week)
c. Part-time (10-20 hours/week)
d. Part-time (<10)
e. Unemployed

Question 10
My reason for taking this course was to satisfy a(n)

a. Elective b. Requirement c. Other

Question 11
Coming into this class, my attitude about an online format was

a. Very positive
b. Positive
c. Indifferent
d. Negative
e. Very negative

Question 12
I mostly accessed the Web site from a computer

a. in the labs in Atanasoff
b. in a lab elsewhere on campus
c. in my home, dorm, or apartment
d. at work
e. other

Question 13
Even though this course has no prerequisites, before taking this course I had experience with the following types of software (check all that apply):

a. Word processing
b. Spreadsheet
c. Database
d. Presentation
e. Web Browsers
f. Web Authoring

g. WebCT

Question 14
The course met my expectations.
a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 15
The course progressed at a fair pace.
a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 16
I got into the WebCT course web site
a. < 1 time a week
b. 1 to 3 times a week
c. 3-5 times a week
d. > 5 times a week

Question 17
I live
a. On campus
b. Off campus but in Ames
c. Commute < 30 miles
d. Commute > 30 miles

Question 18
I found the WebCT site easy to understand and navigate?
a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 19
I found the online chapter resources for *Discovering Computers 2004* (Course Content area) to be helpful in learning the material.
a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 20
I found the following activities helpful in learning the material in this class (choose all that apply):

a. The *Who Wants to be a Computer Genius* game.
b. The *Wheel of Terms* game.
c. The Interactive Labs
d. SAM/TOM software for the applications
e. Weekly online discussions on literacy topic issues.
f. Weekly chapter quizzes.
g. Web page assignments.

Question 21
I found the weekly chapter assignments helpful with learning terminology and chapter content.

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 22
WebCT online chat room was helpful.

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 23
The course schedule was useful.

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 24
The online discussions helped in my understanding and thinking for some of the course material.

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 25
WebCT email was helpful for communication.

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 26
I understood the grading policy.

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 27
My instructor answered my email questions promptly and appropriately?

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 28
I found the computer literacy text book, *Discovering Computers 2004* by Shelly, Cashman, & Vermaat to very useful and informative.

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 29
I found the lab book, *Microsoft Office XP Introductory Concepts and Techniques* , to be very useful and easy to learn from.

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 30
My TA's were friendly, knowledgeable, and helpful.

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 31
I found the web page assignments useful.

a. Strongly agree
b. Agree
c. Neutral
d. Disagree

e. Strongly disagree

Question 32
I learn best from the following kinds of material (check all that apply)

a. Visual (graphs, tables, diagrams, images, animation, etc.)
b. Audio
c. Video
d. Text
e. Multimedia (a combination of the above)

Question 33
I found the following resources to be most useful when I needed help (check all that apply):

a. email
b. online discussion board
c. online chat room
d. TA in lab
e. online instructor in office
f. Help Desk
g. Help resources on non-WebCT site (FAQs, etc.)
h. Fellow students

Question 34
I learn best when working and studying

a. alone
b. in pairs
c. in groups

Question 35
If offered, I would take more online courses.

a. Yes b. No c. Maybe

Question 36
I found the non-WebCT web site, http://www.cs.iastate.edu/~cs103, to be helpful.

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 37
I prefer online tests over written tests.

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 38
I feel less socially connected in an online class

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

Question 39
In an online format versus a traditional large-lecture format,
a. I learn significantly more in an online format.
b. I learn significantly more in a traditional large-lecture format.
c. My learning is approximately the same.
d. I have no opinion.

Question 40
The lab is an important part of this class and is helpful to my success in the course.
a. Strongly Agree
b. Agree
c. Neutral
d. Disagree
e. Strongly Disagree

Question 41
I would like it better if this class was completely online, with no lab component.
a. Strongly Agree
b. Agree
c. Neutral
d. Disagree
e. Strongly Disagree

Question 42
Things I really liked about this class were:

Answer: _____

Question 43

I would make the following suggestions for improvement for this class:

Answer: _____

APPENDIX F. INTERVIEW QUESTIONS

1. How do you think of learning style? Describe your own learning style in this course, please.
2. Do you think if a teacher understands your learning style and preference, does this help you learn and improve your performance?
3. How you feel about learning in WebCT? Do you like it? Why or why not?
4. Is there anything different you have noticed so far when you take this blended course?
5. Are you going to take another online course in the future? Why or why not?
6. What do you think of the weekly lab? Is it useful for you to enhance your computer skills?
7. What you think of this form of learning: lecture in WebCT and face-to-face weekly lab? Is it a good thing or a bad thing? Describe how you feel about it.
8. What do you think of multimedia learning materials, such as audio, video or graphic materials added to the course? Are they helpful to you? Why or why not?
9. Whom do you ask for help if you have any questions about assignment, lecture or technical problems?
10. What do you think of weekly discussion topic assigned by the instructor? Do you find it helpful? Why or why not?